THE IMPACT OF 100kWh FREE ELECTRICITY ON MEETING THE ENERGY NEEDS OF POOR URBAN HOUSEHOLDS

BY

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DECLARATION

I declare that *The impact of 100kWh free electricity on meeting the energy needs of poor urban households* is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

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SIGNATURE DATE

(Ms Karin Lourens)

ABSTRACT

Energy poverty is a major obstacle to human development. Energy services supply the benefits that “trigger” wider social and economic changes and create the conditions for improving social equality and economic growth. The South African government has scaled up electricity access to its poor population to such an extent that 85% of the country’s population had access to electricity in 2017. Nevertheless, access to electricity is not the same as the ability to use it, as the poor find the price of electricity unaffordable. The government therefore embarked on a programme to provide households’ that they consider ‘indigent’ or ‘poor’ 50kWh of free energy. This is criticized by many as not being enough to sufficiently satisfy household energy needs. Even the generous supply of 100kWh electricity provided by the City of Tshwane and the City of Johannesburg municipalities is considered to be insufficient. This study investigates the impact of the 100kWh free basic electricity subsidy on the energy use of the urban poor in the township of Soshanguve in the City of Tshwane municipality. It focuses on whether the 100kWh is enough to meet these household’s’ energy needs. The finding of the study is that the 100kWh FBE is enough to meet these households’ needs for lighting, some cooking and appliance use, but not for space and water heating.

Keywords: developing countries, South Africa, Soshanguve, urban poverty, energy poverty, 100kWh free basic energy, household energy decision making environment, household energy ladder, fuel stacking

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Last, but not the least, mention has also to be made of my cat, Kerneels, who provided emotional and thermal comfort during the long winter months of my literature review and, rather unbearable heat but still welcome emotional support during the long summer months of data capturing and analysis. To you my furry friend, I just say – 'Miaauw'.

Ms. K Lourens

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ABBREVIATIONS

ANC: African National Congress

AGECC: Advisory group on Energy and Climate Change

BMZ: German Federal Ministry for Economic Cooperation and Development

Cosatu: Congress of South African Trade Unions

CH_4: Methane

CO_2: Carbon dioxide

DME: Department of Minerals and Energy

DMR: Department of Mineral Resources

DoE: Department of Energy

DFID: Department for International Development

DPLG: Department of Provincial and Local government

DStv: Digital Satellite Television

EBSST: Electricity Basic Service Support Tariff

ECHDE: Energy Choice Household Decision Environment

ECLAC: Economic Commission for Latin America and the Caribbean

Eskom: Electricity Supply Commission

FBAE: Free Basic Alternative Energy

FBE: Free Basic Electricity

GDP: Gross Domestic Product

GHG: Greenhouse Gas

GWh: Gigawatt hour

HEL: Household Energy Ladder

HDE: Household Decision Environment

HDI: Human Development Index

HIV/AIDS: Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome

IAP: Indoor Air Pollution

IBT: Inclined Block Tariff

IDS: Institute of Development Studies

IDS: Integrated Demand Management

IDP: Integrated Development Plan

IEA: International Energy Agency

IIED: International Institute for Environment and Development

ILO: International Labour organisation

INEP: Integrated National Electrification Programme

JICA: Japan International Cooperation Agency

kWh: Kilowatt hour

LED: Light-emitting diode

LP: Liquid Petroleum

LPG: Liquid Petroleum Gas

LSM: Living standard measure

MDG's: Millennium Development Goals

MEPI: Multidimensional Energy Poverty Index

MS: Microsoft

MW: Mega watts

NDP: National Development Plan

NEAC: National Electrification Advisory Committee

NEF: National Electrification Fund

NELF: National Electrification Forum

NEP: National Electrification Programme

NERSA: National Energy Regulator of South Africa

NGOs: Non-government Organisations

n.d: no date

n.p: no page number

OECD: Organisation of Economic Cooperation and Development

PPP: Purchasing Power Parity

PV: Photovoltaics

RDP: Reconstruction and Development Program

REN21: Renewable Energy Policy Network for the 21st Century

SAARFF: South African Audience Research Foundation

SABS: South African Bureau of Standards

SHS: Solar Home systems

SDG's: Sustainable Development Goals

SD-PAMs: Sustainable Development Policies and Measures

SLA: Sustainable Livelihood Approach

SLF: Sustainable Livelihoods' Framework

SPSS: Software Package for Social Sciences

StatsSA: Statistics South Africa

SWH: Solar Water Heating

TB: Tuberculosis

UCT: University of Cape Town

UN: United Nations

UNCED: United Nations Conference on Environment and Development

UNDP: United Nations Development Programme

UNEP: United Nations Environment Programme

UNISE: United Nations Initiative for Sustainable Energy

UN-REDD: United Nations programme on Reducing Emissions from Deforestation and Forest Degradation

Unisa: University of South Africa

W: Watt

WHO: World Health Organisation

ZAR or R: South African Rand

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CHAPTER 1
INTRODUCTION AND BACKGROUND

1.1 Background and context of the study

Thermal energy, or, energy in the form of heat, is the earliest form of energy used by human beings. There is evidence that pre-humans used fire almost two million years ago in Africa (Albertyn, Rode, Millar & Peck, 2012:792; Malanima, n.d.:3). Fuel sources for fire include wood, animal dung, and other organic matter. The earliest evidence of the use of biomass fuel can be found in the caves of Peking in Asia, where such practices date back almost 500,000 years. The traditional 'three-stone' fire has been in use for almost 12,000 years (Kshirsagar & Kalamkar, 2014:582). Manmade fire has gone from merely providing a means for cooking, lighting, and warmth, to providing a basis for industry and economy (Albertyn *et al,* 2012:792; Malanima, n.d.:2-3).

Since the industrial revolution of the 1800s, many societies replaced the use of wood and biomass fuels with fossil fuels such as coal, oil, and natural gas to meet their household energy needs (Albertyn *et al,* 2012:792). The 1800s saw many breakthroughs in science and technology that facilitated more sophisticated use of fossil fuels. The advent of the 3-phase alternating current power system near the end of the 19th century allowed current to be transmission over a distance (Edison Tech Centre, n.d.). This eventually lead to the electrification of houses and other structures. It has therefore become the go-to technology for powering everything from households to industries and is synonymous with modern development and higher living standards (Moghadam, Mousavi, Moallemi & Nasiri, 2012:299; Smil, 2004:556).

Nevertheless, in 2017, it was estimated that almost 1 billion people, or 15% of the world's population, did not have access to electricity (REN21 2017:19). Approximately 80 to 85% of these people live in Sub-Sahara Africa and Asia (Chaurey *et al,* 2012:48; Sovacool, 2012:274). In Sub-Saharan Africa, two-thirds of the population, did not have access to electricity in 2015 (REN21, 2015:103) and derive 90% of their fuel needs from biomass (OECD/IEA, 2017:6). Access to electricity has slowly improved since 2012 with 100 million households connected to the grids every year since, and electrification rates overtook population growth for the first time in 2014, but a lot more needs to be done to lessen this region's dependence on biomass fuel as the main energy source (OECD/IEA, 2017:6).

Whilst it is possible to say that a lack of access to electricity in developing countries is mostly a rural phenomenon, almost 139 million urban dwellers also lack access to basic electricity (REN21, 2015:103). Although it is also true that urban dwellers have more *choices* when it comes to using different types of energy to meet their household energy needs, (UNDP, 2002: 8), Sovacool (2012: 273-274) mention that urban dwellers pay much more for usable energy because of the inefficiency of their energy technology. Furthermore, the Economic Commission for Latin America and the Caribbean (ECLAC) (2009:15) claims that urban dwellers do not have the free access to wood and biomass which rural dwellers have. As a result, urban poor struggle to meet their household energy needs. Typically, an urban household makes use of a mix of energies to meet their needs such as candles and kerosene lamps for lighting, and wood, coal, charcoal, kerosene, liquefied petroleum gas (LPG) and electricity (when available) for cooking and heating purposes (UNDP, 2011:38; UNDP, 2002:9).

Unfortunately, some of these fuels are dangerous, polluting and hazardous to people's health and the environment. Wood burning, for instance, releases gasses such as carbon monoxide, nitrogen oxides, and other dangerous chemicals, which concentrate in people's small living spaces and cause high concentrations of indoor air pollution (IAP). Kerosene, also known as 'paraffin' in South Africa, is widely used in poor urban areas for lighting, cooking, and heating. Studies show that inhaling kerosene gasses can lead to lung infections, TB, asthma, and can also lead to some cancers (Lam, Smith, Gauthier & Bates, 2012:396).

The World Health Organisation estimate that roughly 4.3 million people die from IAP yearly globally (WHO, 2016b:70). The elderly, women, and children are the most vulnerable. Almost 60% of those who die from IAP are women, and children under the age of five (WHO, 2016b:70).

The United Nations has made it clear that addressing the issue of energy poverty is crucial to achieving the internationally adopted Sustainable Development Goals. The UNDP already noted in 2002 that "…when poor people and communities obtain access to convenient and efficient energy services, one major barrier to poverty reduction can be lowered or removed" (UNDP, 2002:3-4). The DFID (2002:6) also stresses the importance of not neglecting the urban poor in energy policies. In the light of the expected rise in rural-urban migration and urbanisation, where rural poverty is likely to be transferred to urban

poverty; this sector will need a lot of attention in the future. Consequently, Sustainable Development Goal seven of the new Millennium Development goals, adopted in 2015, aims to “ensure access to affordable, reliable, sustainable and modern energy for all” (United Nations General Assembly, 2015:35).

The South African government has committed to achieving the international Sustainable Development Goals. In fact, the South African government’s commitment to meeting its poor’s energy needs started in the 1950s with the adoption of the African National Congress’s Freedom Charter. This document stressed the importance of poor people’s socio-economic rights to ‘house, security, and comfort’ (Bekker, Gaunt, Eberhard & Marquard, 2008b:3128). This was made concrete after the first democratic elections in 1994 with the adoption of the government’s Reconstruction and Development Program (RDP) which aimed to provide basic services of water, electricity, housing, education and health to all South Africans, and especially to those who had previously been excluded from it (Bekker *et al,* 2008b:3128).

As part of its goal to address the unequal access to energy left by the apartheid government, the South African government launched a National Electrification Programme (NEP) in 1994 (Ballantyne, 2012). The first phase of the NEP focused on providing electricity to poor urban areas and managed to connect schools and clinics formerly without electricity to the national grid (Prasad & Visagie, 2006:1). In 1994, only 30% of the country’s population had access to electricity. Statistics from the national census in 2001 showed that 58.2% of all South African households were using electricity for lighting (Statistics South Africa, 2005:114). It meant that the government and its partners managed to connect almost two thirds of the country’s population to the grid within the space of 6 years. Although the urban-rural ratio for connections was still 80%/46% (Winkler, 2006:25), this is a major achievement.

The second phase of the NEP aimed to extend the grid to rural areas. This second phase of the NEP were not as successful as the first and encountered many problems in its implementation. Nevertheless, according to the DoE, around 85% of all South African households were connected to the grid in 2017 (DoE, 2017:12).

In 2003, the Department of Minerals and Energy (DME) introduced a Free Basic Electricity (FBE) or electricity basic service support tariff (EBSST) to its poorest consumers (Prasad & Visagie 2006:1). This was done, as government realised that the NEP would not be accompanied by meaningful levels of electricity consumption among poor households if they

were unable to afford the use of electricity (Mapako & Prasad, 2005:1). Also, one of the stated objectives of the FBE was to enable poor households to lessen their dependence on 'dirty fuels'. As a result, all households in South Africa were given 5 to 6 kWh free electricity per month (DoE, 2013:6). This provides enough electricity to power at least three low-energy light bulbs and ensures that all households have access to adequate lighting (DoE, 2013:72). In addition to this, households that are connected to the grid and are considered 'indigent', or loosely speaking, 'disadvantaged and poor', qualify to apply for at least 50kWh of free electricity from their municipalities (Prasad & Visagie, 2006:1).

An early study done in 2005-2006 by Howells, Victor, Gaunt, Elias, and Alfstad in urban Kayelitsha, showed that very poor households in urban settlements typically used about 20kWh of electricity per month. They used this for television, lighting, irons, and a few other applications. Electricity was not used for cooking, as cooking is an energy intensive application and residents prefer to use fuels such as coal or firewood for cooking. As a result, the urban poor continued to make use of multiple fuels for cooking and heating.

After the introduction of the 50kWh FBE, households' electricity usage went up to about 35kWh per month and many households purchased and used electric cookers, as well as electricity for heating water. This pushed their electricity usage up to about 50kWh per household per month. Howells *et al* (2006:7) found that this lessened households' reliance on polluting fuels, and the reduced expenditure on energy meant that funds could be put towards meeting other needs.

However, since 2005, the price of electricity and consumer prices in South Africa went up considerably. A report by Earthlife Africa in 2010 (Adam 2010) found that the 50kWh free electricity was not enough to meet poor households' energy needs. Maconese, Kimemia and Annegarn (2012) also found that the 50kWh free electricity was insufficient to cover basic cooking or refrigeration needs and did not allow households to move away from using 'dirty' fuels.

Other criticisms levelled at the 50kWh free electricity was that it did not consider the needs of larger sized urban households (Makonese *et al,* 2012). Authors such as Makonese *et al* (2012), even claim that 100kWh free electricity, which is issued by the metropolitan municipalities of Johannesburg and Pretoria, will still be insufficient to cover poor households' energy needs. As a result, there has been proposals by some organisations like Cosatu and Earthlife Africa that the FBE should be increased to 200kWh per household

(Adam, 2010:6). Nevertheless, no comprehensive studies have yet been done to measure the impact that the 100kWh FBE has in meeting household energy needs or to what extent it as assisted the poor to move away from using multiple fuels.

The aim of this study then is to fill this gap by investigating the impact of the 100kWh of free electricity on household energy use for lighting, cooking, space, and water heating, appliance use and concomitant improvement of living standards. The focus area of the study is the township of Soshanguve, an urban suburb located 25 km to the north of the Tshwane City Centre (the country's executive capital) in northern Gauteng.

1.2 Problem Statement

A literature review on multiple energy use in urban areas of the developing world reveals many gaps. Most studies on energy poverty have a tendency to focus on rural areas in developing countries, which is not surprising, as 87% of the world's population who do not have access to electricity, reside in rural areas. Nevertheless, as already mentioned, the DFID (2002:6) stresses the importance of not neglecting the urban poor in energy policies. Urban energy poverty need to be fully understood for developing country governments to devise policies to affectively address this issue.

Pauri and Spreng (2011), Rehman, Kar, Banerjee, Kumar, Shardul, Mohanty and Hossain (2012) and Nussbaumer, Bazilian and Modi (2012) also make the point that considerable work still needs to be done to accurately measure household energy poverty. In practice, many variables interfere with the production of accurate statistics. One of the impediments to understanding household energy poverty is the fact that researchers tend to focus only on one energy application, for instance cooking, or the use of a specific fuel, such as biomass.

All studies done on energy poverty is helpful to gain insight into the complex nature of the energy-poverty nexus. However, this will only yield fragmented glimpses into certain aspects of energy use and does not always provide a holistic picture of the dynamic environment of household energy use. Furthermore, most studies do not deal sufficiently with the incidence of energy vulnerability, as is, for instance, the case with varying seasonal demands on the household energy use of the very poor. Organisations such as the World Health Organisation (WHO) are also particularly concerned about the lack of research done on the use of kerosene, especially with regards to space heating (WHO, 2016b:47).

Furthermore, studies that focus on government subsidies for household energy focus mostly on the subsidy of LP gas and kerosene, and not on electricity. South Africa is one of the countries that subsidise electricity to its poor, but few studies have been conducted to fully understand the impact of the various allocations of FBE on the energy use and living standards of the urban poor. To date, no studies have been done to investigate or measure the impact of the 100kWh of free electricity on the energy use and living standards of the households who receive it. Only two municipalities in South Africa currently grant 100kWh FBE to those who are considered 'indigent'. They are the city of Johannesburg and the city of Tshwane.

A mini dissertation done by Tebogo Brenda Sole (2015) titled "*Women's fuel choices and fuel stacking practices in urban households: A narrative study*" focus on the multiple fuel practices of nine women in Soshanguve. The results of her study show the complex and dynamic interplay between socio-economic, political and cultural factors that affect women's energy choices in the home. Her sample also included a few participants who receive the 100kWh FBE. Nevertheless, the small scope of her study makes it hard to generalise findings. She co-published an article with Clair Wagner in 2016 where they encourage further research:

> "The use of a small sample…introduces bias in the data in that the participants' multiple fuel practices may not represent those of the rest of the community. The findings from this study open the door for future researchers to investigate the topic on a larger scale, using quantitative methods and random sampling to gather more representative evidence of people's fuel needs and practices…" (Sole & Wagner, 2016:9).

These gaps in the literature need to be addressed and it is important to investigate the impact of the 100kWh of free electricity on household energy use for lighting, cooking, space and water heating, and appliance use to design efficient policies to deal with urban energy poverty for the country's future.

1.3 Research Objectives

1.3.1 Research Objectives

1. To investigate the impact of the 100kWh FBE on meeting household energy needs for lighting, cooking, space and water heating and powering appliances
2. To establish the impact of the 100kWh FBE on the incidence of multiple fuel use and ‘fuel stacking’ for households who receive it.
3. To establish the impact of the 100kWh FBE on household seasonal poverty

1.3.2 Key Research Questions

- How satisfied are respondents with the introduction of the 100kWh FBE in meeting their needs for lighting, cooking, space and water heating and powering appliances?
- How did the introduction of the 100kWh FBE change people’s energy use for lighting, cooking, space and water heating and powering appliances?
- What is the incidence of multiple fuel use amongst households that do not receive the FBE?
- Did the introduction of the 100kWh FBE assist households to reduce multiple fuel use and to move away from using ‘dirty fuels’?
- What is the incidence of seasonal poverty amongst households in the study and does the introduction of the 100kWh FBE enable households to cope with seasonal poverty?
- Did the introduction of the 100kWh FBE lessen ‘energy poverty’ and increase beneficiaries’ living standards?
- What is the consequences of energy poverty?
- What are the determining factors in Soshanguve’s energy choice household decision environment that influences choice with regards to energy use?
- What do respondents indicate government can do to assist them to meet their energy needs?

1.4 Delimitation of the study

1.4.1 Study focus

Firstly, this study focus on *households*. According to Chambers and Conway (1998:6) a household refers to “the human group which shares the same hearth for cooking”.

Secondly, this study focuses on households that fall within the *lowest standards of living* category in South Africa. This category falls within an index that has been developed by the South African Audience Research Foundation (SAARFF) and is used as a marketing research tool (Haupt, SAARF). The Living Standards Measure (LSM) index groups the South African population into ten groups based on various criteria. This index is important as it has been adopted by the Department of Energy (DoE) to operationalize its 2012 survey titled *“A survey of energy-related behaviour and perceptions in South Africa – The Residential Sector”* (DoE, 2013). The ten categories are grouped into three categories – Low LSM, Medium LSM, and High LSM. These are again subdivided (DoE, 2013:viii). The subdivision is as follows:

- Low LSM - LSM1 to LSM 3
- Medium LSM - LSM 4 to LSM 6
- High LSM - LSM 7 to LSM 10

Although the LSM do not usually use household income as a living standards indicator, the South African government does allocate average household income values per LSM category in its “Development Indicators” reports. The last report was published in 2014. Table 1.1 shows the LSM household income values from 2009 to 2013.

Table 1.1 South African Living Standards Measure 2009 to 2013

	2009		2010		2011		2012		2013	
	No (000)	Imputed avg. monthly household income	No (000)	Imputed avg. monthly household income	No (000)	Imputed avg. monthly household income	No (000)	Imputed avg. monthly household income	No (000)	Imputed avg. monthly household income
LSM 1	1 031	R 1 386	808	R 1 448	661	R 1 369	575	R 1 641	526	R 1 480
LSM 2	2 436	R 1 564	1 944	R 1 859	1 793	R 1 952	1 422	R 2 155	1 342	R 2 218
LSM 3	2 610	R 2 116	2 394	R 2 153	2 117	R 2 545	2 171	R 2 465	2 140	R 2 585
LSM 4	4 641	R 2 580	4 744	R 2 966	4 248	R 3 141	4 526	R 3 355	4 332	R 3 205
LSM 5	5 153	R 3 627	5 636	R 3 965	6 080	R 4 200	5 965	R 4 259	6 087	R 4 344
LSM 6	6 086	R 5 990	6 891	R 6 573	7 828	R 6 454	7 898	R 6 680	8 836	R 6 822
LSM 7	3 182	R 9 694	3 621	R 10 081	4 014	R 11 022	4 003	R 11 244	4 572	R 11 882
LSM 8	2 449	R 13 188	2 830	R 13 979	2 921	R 14 877	2 994	R 15 736	3 276	R 16 754
LSM 9	2 895	R 17 809	3 038	R 18 860	3 093	R 20 667	3 278	R 21 555	3 703	R 23 539
LSM 10	2 015	R 26 602	2 114	R 28 038	2 177	R 30 559	2 102	R 31 111	2 400	R 36 883

Source: Department of Planning, Monitoring and Evaluation 2014: 28

This study focuses on the households that fall into the Low LSM category, in other words LSM 1 to 3. The average income for a household in the LSM 3 category was ZAR2, 585 in 2014. Because of the fact that no recent data is available on household income per LSM category, the researcher decided to adopt the income criteria of ZAR4000 a month as a yardstick for households in the LSM category. For the purposes of this study then, the focus is on households that do not earn more than ZAR4000 a month.

Thirdly, the researcher focuses on two categories of households:

- Households that are connected to the grid but do not receive the 100kWh FBE
- Households that are connected to the grid and receive the 100kWh FBE

According to the results from studies done on fuel use in poor urban areas in South Africa by authors such as Makonese *et al* (2012) and the information obtained through the qualitative part of the study, the residents of Soshanguve tend to use electricity illegally by tampering with their pre-paid electricity meters. This is a concern, as random sampling runs the risk of sampling households whose data does not give an accurate picture of energy poverty and multiple fuel use for households in the lowest LSM. Thus, fourthly, the researcher organized the sampling procedure in such a way that the sampling of such households could be avoided. Consequently, this study used purposeful and not random sampling as a sampling technique. This sampling procedure is explained in Chapter 5.

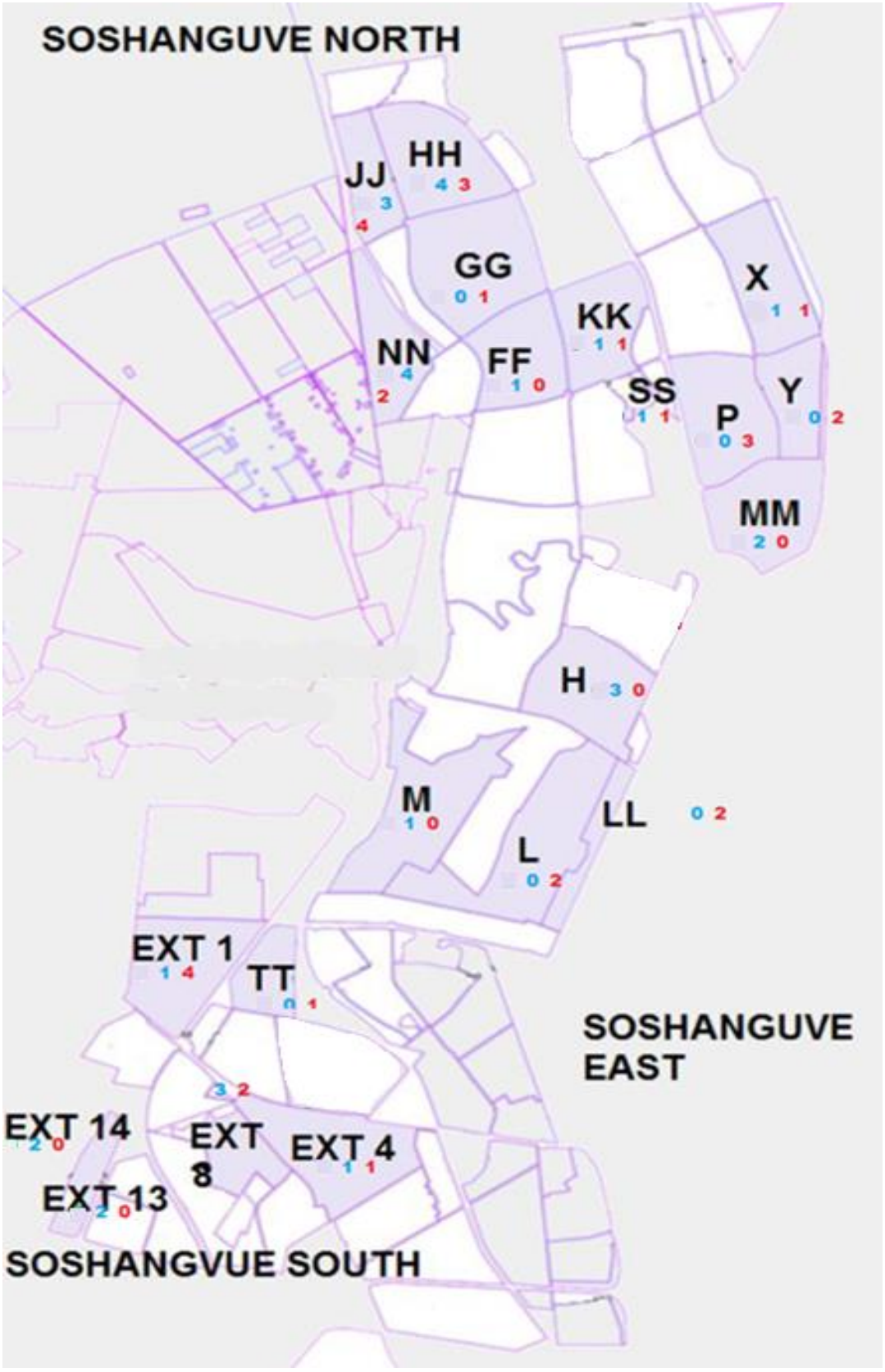
Fifthly, this study does *not* follow a gender perspective as so many studies on household energy use do. Authors that follow a gender perspective in energy studies such as Annecke (2005) and Sole and Wagner (2016) make valid points when they say that women are the

energy ‘managers’ of their families because of their traditional roles as cooks and housekeepers and that studies on energy use cannot neglect their voices. The researcher found early on in her field research that it was not considered culturally acceptable to bypass the male breadwinner of the family in discussions on household energy use and that it was not wise from a research perspective, as male breadwinners are often in charge of household budgets, expenditure and appliance acquisition. As a result, the study represents both male and female voices on energy use. Nevertheless, the sample population of the study ended up being mostly female (75%). This was because the field assistants are all female and found it easier to approach other women. Some of the respondents were single men who do their own cooking and household chores.

It must be said that the original scope and focus of the study was much wider than the final product. The original focus of the study was also to investigate the impact of electricity access on household energy use and the original sample consisted of thirty households that do not have access to electricity, thirty that do but do not receive the 100kWh FBE and those that do. The original survey questionnaire was therefore designed to focus on all three categories of households.

Furthermore, the study also included a focus of the impact of load-shedding and higher electricity prices on household energy use as part of focus on household energy vulnerability. It became apparent during writing the data analysis chapter that the focus of the dissertation was too wide and that it had to be narrowed. Figure 1.1 show the final sample area and number of households sampled.

Figure 1.1: Map of geographic location and number of households sampled



Households with electricity that do not receive the FBE

Households that receive the FBE

Source: Adapted from Map of Soshanguve, City of Tshwane Geomatics, 2017

1.4.2 Theoretical delimitation

1.4.2.1 Energy poverty

The South African Department of Energy (DoE) uses an expenditure approach to measure poverty. In the *expenditure approach*, a house is energy poor if it spends more than 10% to 15% of its total income on energy (DoE, 2013:viii). This is also the official definition followed by the United Nations and its development affiliates. The researcher will use the *expenditure approach* as a definition of 'energy poverty' in this study.

1.4.2.2 The Energy Choice Household Decision Environment

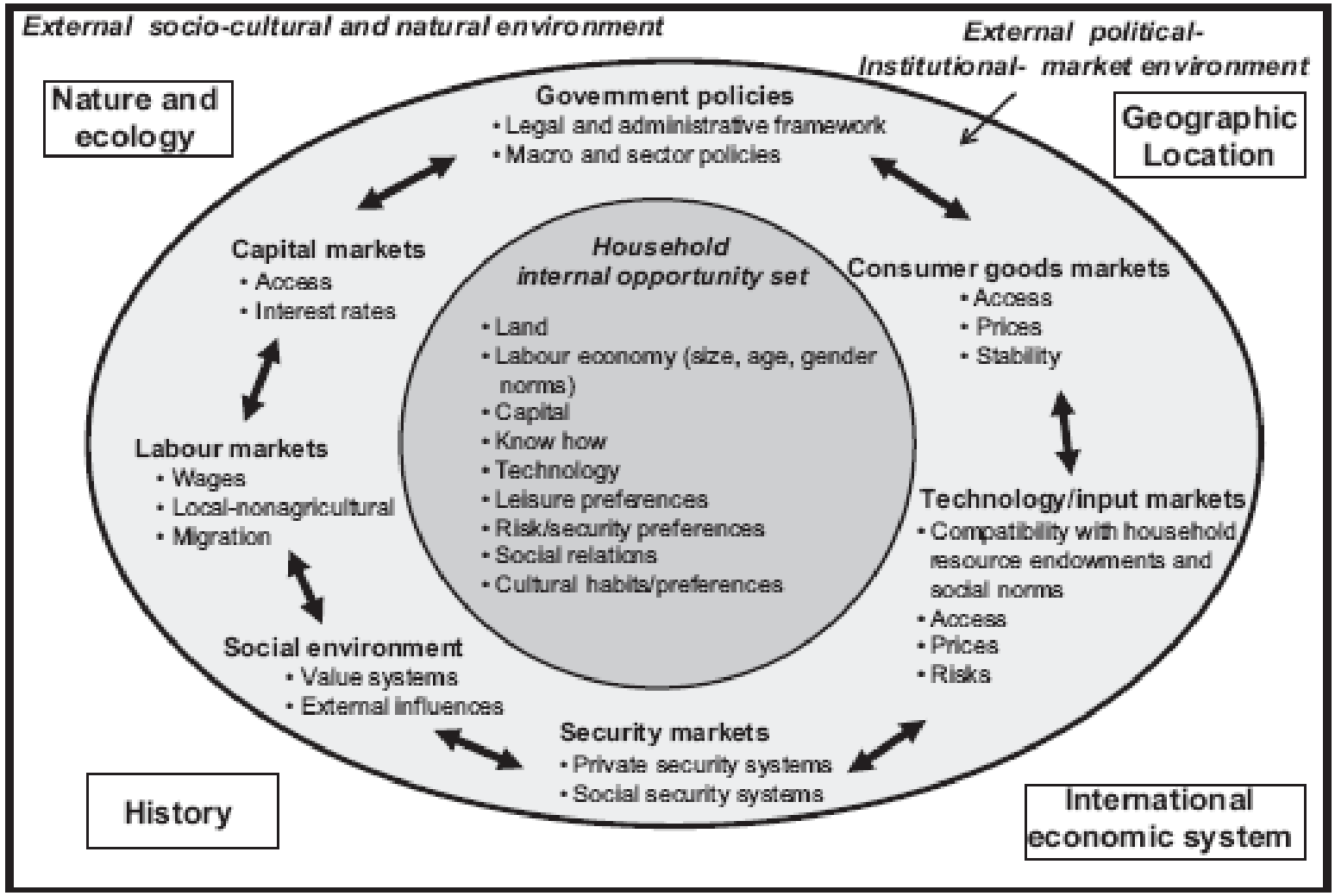
This study will make use of the 'energy choice household decision environment' framework or ECHDE of Van der Kroon, Brouwer and Van Beukering (2013). They adopted a framework from Bruntrup and Heidhues' 2002 work to explain the factors that influence the decisions that households make when it comes to choosing their household energy strategies (Van der Kroon *et al,* 2013: 507). These factors are called the 'household decision environment' or HDE. Figure 1.2 on page 14 explains the conceptual framework for the ECHDE.

As can be seen from the framework, the ECHDE is a complex, interactive web of factors and consists of three dimensions or categories. On the outside, there is the country *external environment*, which shapes the boundaries within which the society functions. This can be its geographical location, climate and history (Van der Kroon *et al,* 2013:507). Secondly, there is the *decision context*, which reflects the country's internal and the household's external environment which involves the political, institutional and market factors of a certain community, for instance the influence of government policies, the retail environment etc. Thirdly, there is the *household opportunity set.* This refers to the internal factors specific to a household that influence their HDE, such as their assets.

The ECHDE ties in narrowly with the Institute of Development Studies' sustainable livelihoods approach, which focuses on the 'capitals' or assets of individual households. These capitals can be social, human, natural (environment) and physical assets (infrastructure and municipal services) and they work together to strengthen a household's ability to have a secure livelihood (Arce, 2003:203). In the HDE, the 'household opportunity

set’ or assets also include factors that are pertinent to energy use. For instance, higher education levels (human capital) are associated with better knowledge about fuels that will influence energy decisions, etc. The interaction between categories determines the HDE and will be unique to each household.

Figure 1.2: The Energy Choice Household Decision Environment



Source: Van der Kroon et al (2013:507)

1.5 Research Methodology

1.5.1 Desktop study

The first stage of the study consisted of the consultation of secondary sources such as a literature survey, peer reviewed articles and research papers, and government published documents. The researcher used the University of South Africa's (Unisa) online library as well as Google Scholar for her literature search. It must be said that the literature review for this study was already conducted in 2015, as a result many of the sources that were used date from the beginning of the decade. Nevertheless, the researcher searched continuously for new publications during 2016 and 2017 and where necessary, updated statistics. As many of the most important work on energy research was conducted at the beginning of the millennium and not much newer studies had been conducted on these themes and topics, the data from these sources are still relevant. Where necessary, the researcher made special reference to the publishing date of the data to put the findings into a time perspective.

1.5.2 Field Work

Field research has been conducted using qualitative and quantitative research techniques. (See Below)

1.5.3 Research Methods and Techniques

1.5.3.1 Qualitative sampling

(1) Informal interviews

The researcher was fortunate to have a good friend that lives in Soshanguve in Block Y who agreed to assist her with her study. Many informal interviews were conducted with her about her life, living conditions, household routine, energy use, and her culture as well as insights into the energy use and strategies of her family, friends, neighbours, and community. This friend also acted as field assistant during the qualitative and quantitative part of the fieldwork. Informal interviews were also

conducted with the field assistants throughout the course of the study (See section 1.4.3.2 on field assistants).

(2) Semi-structured interviews

The researcher's friend introduced her to her family and neighbours in Block Y in Soshanguve. The researcher conducted semi-structured interviews with her friend's father and a neighbour that was home on the day. The interviews were not recorded as the researcher did not want to inhibit the participants or make them feel uncomfortable. As a result, written notes were taken. Unfortunately, the security situation in Soshanguve deteriorated thereafter as it was just after the municipal elections and the researcher was seen to represent a political party that had just won the municipal elections. This party is not popular in Soshanguve. Consequently, it was not safe to enter Soshanguve.

(3) Structured interviews

As a result, the researcher drew up a pilot structured interview schedule with open-ended questions and her friend continued with the interviews. The friend, now field assistant, conducted the interviews with her neighbours with whom she was well-acquainted and made comprehensive notes. Each interview was followed up with a debriefing session and the interview schedule was continuously revised and adjusted to allow for the generation of more accurate and reliable data. In the end, some of the participants were interviewed more than once to fill in missing gaps in the data.

(4) Focus group discussion

In addition to the field assistant who assisted during the qualitative part of the field research, the researcher employed seven students who live in Soshanguve to act as field assistants for the quantitative part of the study. After the data analysis was completed, a focus group discussion was held with the field assistants to present the data and to discuss anomalies and discrepancies in the data as well as certain patterns or trends.

1.5.3.2 Quantitative sampling

The researcher employed seven students to assist with the quantitative part of the research. These students were enrolled in courses in the school of Social Sciences at Unisa. The survey questionnaire was based on the most important data and patterns that arose from the results of the interviews.

The field assistants did *not* follow a random sampling procedure, but deliberately approached family members, friends and neighbours that they know well and who they knew earn less than R4,000 a month and *do not use electricity illegally*. As already mentioned, the original sample consisted of thirty households that do not receive electricity, thirty that do and thirty that do and received the FBE. For the purposes of this dissertation though, the total sample of households in the survey is sixty households.

1.5.4 Data Analysis and Presentation

The student used IBM's SPSS to capture and analyse the data of the survey. Some of the data was also generated manually with the assistance of MS Excel. The Data Analysis chapter only contains tables and no graphs or charts.

1.6 Ethical Considerations

1.6.1 Introduction

Permission for this study was obtained from the Unisa Ethics committee in 2014. The researcher then sought and gained permission from the city of Tshwane municipality to conduct the study. The student also obtained the endorsement of the DoE's project manager of the DoE's 2012 survey of energy related behaviours and perceptions in South Africa. The researcher also obtained permission from the Unisa registry office to obtain and use the list of students that are enrolled in the College of Human Sciences' courses that live in Soshanguve.

1.6.2 Selection of participants

In the qualitative part of the study, participants were asked if they would like to participate in the study. The field assistant was informed about the ethics of research. Many of the field assistants that took part in the survey were students in their final practical year in the Social Work course and as such has already passed a course in research and research ethics. Participants was considered as partners in the research process and not subjects. The participants did not receive any remuneration for their participation, but they did get the opportunity to voice their concerns and needs with regard to their household energy problems.

1.6.3 Informed consent

Informed consent was sought and obtained from each prospective subject. Each questionnaire contained a section where each participant could give written consent. In the qualitative part of the research, the results of the interviews were written up under the pseudonyms of the participants and distributed to them. They had the opportunity to read through the write-up of their interviews to see if it was accurate and acceptable to them. As these write-ups were already furnished with pseudonyms this also reassured them of their anonymity.

1.6.4 Confidentiality of information

The researcher ensured the confidentiality of the information collected in both the qualitative and quantitative part of the research process. This includes producing and storing information is such a way that it protects the participants' and respondents' identities and ensures that the field assistants also respect this principle.

1.7 Outline of the Study

1.7.1 Chapter 2 – Urban Household energy use in poor countries: A Literature review

The review of related literature starts with the definition of important concepts used in this study. They are 'poverty', 'basic needs', 'livelihood capitals', 'sustainable development' and 'indigency'. The second part of this chapter is devoted to understanding the concept 'energy poverty'. This discussion starts with an overview of the status of global energy poverty and

focuses on its incidence in Sub-Sahara Africa. It then examines different ways in which 'energy poverty' is measured and stresses the importance of energy in development. The third part of the chapter looks at the two most dominant theories of energy use namely the 'household energy ladder' and the 'fuel stacking' theory. The theories and models of these perspectives are explained, and the specific fuels of the 'energy ladder' are discussed. The discussion focuses specifically on the nature of its use in developing countries as household fuels and the health and environmental consequences of the use of these fuels.

1.7.2 Chapter 3 –The Energy Choice Household Decision Framework

Kroon, Brouwer and Van Beukering's (2013) Energy Choice Household Decision Environment (ECHDE) forms the theoretical framework for this study. This framework consists of three dimensions, namely 'the household opportunity set', the 'external decision context' and the 'external environment'. These three dimensions are discussed, and certain aspects of this model correlates are shown with the aid of the 'sustainable livelihood approach' of Scoones (1998). The chapter also discusses factors which are important in the HDE that are not originally included in Van der Kroon *et al*'s ECHDE. Lastly, the external context of South Africa's ECHDE is discussed with specific reference to the country's quest for universal energy access, the introduction of the free basic electricity initiative and its results. Lastly, South Africa's current household fuel use patterns are discussed with special reference to the fuel use of the poorest households.

1.7.3 Chapter 4 –Study Area: Soshanguve

The focus area for this study is the urban, semi-formal area called Soshanguve, situated 25 km north of the city centre of Pretoria (Tshwane). Tshwane is located in Gauteng province and is the Capital of South Africa. The first part of the chapter expands on the demographics of Soshanguve, relative to its surrounding. Factors which are discussed, is poverty, employment, housing, level of education and other demographic statistics. The second part of the chapter examines the issue of electrification in Tshwane municipality, the introduction of the 100kWh FBE and the roll-out of the solar water heater program in this municipality. Lastly, the chapter looks at some case studies of multiple fuel use in other urban areas of Gauteng province and in Soshanguve specifically, based on a study by Tebogo Sole in 2015.

1.7.4 Chapter 5 – Research Methodology

The first part of this chapter focuses on explaining the qualitative part of the study. This includes a description of the sampling and data collection techniques. The researcher used informal interviews, semi-structured interviews and structured interviews to obtain data for the qualitative part of the study. A focus group discussion was used at the end of the study to triangulate findings and to allow feedback from the research assistants into certain patterns in the data. The second part of the chapter focuses on the quantitative part of the study. This discussion looks at the survey questionnaire, the selection and training of field assistants, sampling criteria and some problems experienced during the survey. Finally, the chapter looks at the way in which data was analysed and presented.

1.7.5 Chapter 6 – Data Analysis

The data analysis chapter is structured according to the three main objectives of the study. Firstly, though, the chapter examines the household 'opportunity set' and demography of the households involved in the study.

The second part of the chapter focus on the first objective of the study, namely to investigate the impact of the 100kWh FBE on household energy use for meeting lighting, cooking, space and water heating and powering appliances for households in the qualitative as well as the quantitative part of the study. All discussions in this chapter firstly start by looking at the results from the interviews first. This analysis also tries to determine whether the FBE was able to improve the living standards of the households who receive it.

The third part of the chapter focus on analysing data to establish the impact of the 100kWh FBE on the incidence of multiple fuel use and 'fuel stacking' for the households in the study. In order to introduce the topic of multiple fuel use and 'fuel stacking' though, it is firstly necessary to understand the factors in the Soshanguve ECHDE that influence household decisions-making regarding energy choice. Consequently, the reasons why people choose the energy they do will be analysed. The incidence of multiple fuel use by households in the study who do not receive the FBE and those who do will be compared to establish whether the introduction of the FBE has enabled the households in the study to lessen their use of 'dirty' fuels.

Fourthly, the incidence of household seasonal poverty amongst the households are analysed. The goal of this analysis is to determine the incidence of seasonal poverty amongst the households in the study and whether the 100kWh are able to alleviate seasonal poverty. The general consequences of energy poverty are also discussed as identified by the participants of the study. Lastly, the chapter look at the suggestions that the participants have put forward to government on how it can assist them to meet their energy needs.

1.7.6 Chapter 7 – Summary, Findings, Recommendations and Conclusion

This chapter focus on summarising the main points and findings of this study relating to the main objectives. The researcher makes recommendations based on the findings and then conclude with some observations and suggestions for future research.

CHAPTER 2
URBAN HOUSEHOLD ENERGY USE IN POOR COUNTRIES: A LITERATURE REVIEW

2.1 Introduction

This chapter focuses on the relevant concepts, theories, and models that relate to defining and explaining household energy use in poor countries. It also looks at the different energy sources that are used by poor households and put its use into perspective by focusing on its impact on human health and the environment. This chapter will show that an investigation of the desirability of using certain types of energy sources is crucial to policy making.

To put the issue of energy poverty into a broader perspective, it is firstly important to understand the definition of 'poverty'. Poverty is a relative concept, but for the purpose of this study, the researcher adopted a 'poverty line' approach to guide the sampling process. Furthermore, the South African government has adopted a policy of granting assistance to households that are considered 'indigent' (DPLG, 2006a:13). These households receive a free basic electricity subsidy and as such, the criteria and definition of 'indigency' will be discussed.

Any study on energy poverty also needs to take into consideration the concept of 'basic needs'. Energy is a vital basic need that forms the foundation for higher living standards and wider development. This study will thereafter examine the issue of household energy within the wider context of 'sustainable development' and argue that access to electricity is an asset to a household and support its ability to cope and limit its overall livelihood vulnerability. Consequently, this chapter also examines the concept of energy as an asset that strengthens household 'livelihood capitals'. Energy as an asset is also part of the foundation of the theoretical framework of this study. Here the researcher employs the 'Energy Choice Household Decision Environment' model. This will be discussed in greater detail in the following chapter.

The concept of 'energy poverty' is also discussed. It is placed within its international context and its various definitions are explained. Finally, this chapter explore the two most dominant models that attempt to explain household energy use in developing countries. These are the 'household energy ladder' theory and the 'fuel stacking' theory. The different energy sources that form the components of the 'household energy ladder' are discussed individually.

2.2 Key Concepts

2.2.1 Poverty, Basic Needs, Livelihood ‘Capitals’, Sustainable Development, and ‘Indigency’

Poverty is difficult to define as it is a relative concept. Nevertheless, the idea that households need a minimum weekly income to survive was popularised by the English philanthropist Charles Booth at the end of the 19th century. He called this minimum income ‘the poverty line’ (Brown, 1968:351). This perspective had a lot of influence on English social policy in the early 20th Century and was adopted by the international institutions tasked with world development after the Second World War.

Although other perspectives of poverty also became important, the perspective of measuring poverty in terms of levels of income, GDP, and employment are still used today by the United Nations (UN) and the World Bank to gauge global poverty (Kruger, 2007:24). This minimum income or ‘poverty line’ is officially used as the terms ‘absolute poverty’ or ‘extreme poverty’. According to the World Bank, households need to earn more than $2 a day to not be classified as ‘absolutely poor’ (World Bank, 2013:8). This figure has been continuously revised to reflect higher price levels and purchasing power parity between developing countries (Sovacool, 2012:273).

Measuring poverty by an absolute threshold does have its advantages. For example, it enables researchers to apply the same standard across time and space and thus makes comparisons easier. Nevertheless, it has limitations in describing the picture of poverty fully, for instance, it does not help us understand ‘relative poverty’ from people’s own perspectives (United Nations Department of Economic & Social Affairs, 2009:63; Forster, 1998:335).

In 1943, the phycologist Abraham Maslow published a paper in the Psychological Review titled "A Theory of Human Motivation". His paper proposed that people satisfy their needs according to a hierarchical order that includes five levels of basic needs. These are:

1. Physical or survival needs such as air, access to water, food, clothing, shelter, and sex.
2. Physical security, financial security and access to resources, health security and the need for safety nets against unforeseen circumstances.

3. The need to be loved and to belong. Individuals satisfy this need through interpersonal relationships.
4. The desire to be respected, to have self-esteem, self-respect, confidence, and to achieve.
5. The need to fulfil one's full potential, to be creative, spontaneous, have a sense of morality and to be without prejudice (Gambrel & Cianci, 2003:145).

Maslow's views have been highly influential in forming opinions about the definition of 'human development' in the middle of the Twentieth Century. As a result, the concept of poverty came to be understood as 'the inability of an individual or household to fulfil their basic needs' (DFID, 1999a). This understanding was further built upon in the 1980s by scholars like Amartya Sen who drew attention to the importance of people's capabilities and access to resources as a determining factor in understanding their poverty (Japan International Cooperation Agency, 2002:177).

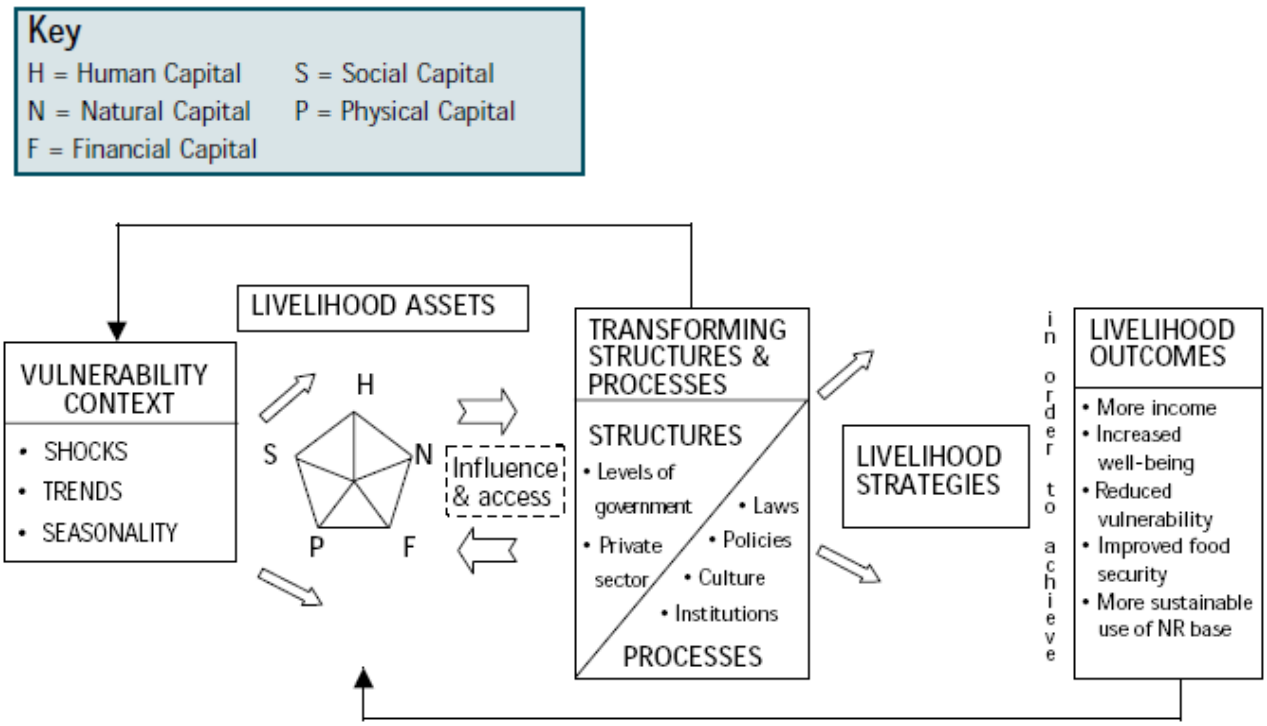
In the early 90's, scholars such as Robert Chambers at the Institute of Development Studies (IDS) also observed that the poor suffered from various disadvantages which worked together to 'trap' them into 'cycles of poverty' and deprivation. Disadvantages include lack of capital or funds, physically weakness, isolation, vulnerability and powerlessness (De Beer & Swanepoel, 2011:5; Arce, 2003:203). Chambers was concerned about how people's vulnerability could be minimised and how their security could be maximised. As a result, he advocated the concept of 'sustainable livelihood securities' (Arce, 2003:202). Instead of only focusing on people's income, he recognised the importance of strengthening poor people's reserves and contingencies, or net 'assets' as he called them, to strengthen their livelihood security (Arce, 2003:203). This is called the 'sustainable livelihood's approach' or SLA.

The work of Chambers was built upon by Scoones (1998) who developed a sustainable livelihood framework to explain how various factors and people's 'capitals' or 'assets' work together to secure for them a sustainable livelihood. The sustainable livelihoods framework (SLF) expresses the following question:

> Given a particular context (of policy setting, politics, history, agroecology and socio-economic conditions), what combination of livelihood resources (different kinds of capital) result in the ability to follow what combination of livelihood strategies (agricultural intensification/extensification, livelihood diversification and migration) with what outcomes? (Scoones, 1998:3).

Scoones' livelihood framework is represented in Figure 2.1

Figure 2.1: The Sustainable Livelihoods Framework



Source: Adapted from DFID (1999b)

The SLF consists of five main components: the vulnerability context, livelihood assets, transforming structures and processes, livelihood strategies and livelihood outcomes.

Livelihood assets or capitals refer to the human, natural, financial, physical, and social strengths that people possess and can draw on in a livelihood strategy to achieve a positive livelihood outcome. *Human capital* refers to peoples' education, skills and health. *Natural capital* refers to the natural resources that people have access to and can utilise from their natural environment. *Financial capital* refers to the financial resources that are available to people such as savings, supplies of credit, remittances, government subsidies, pensions etc. *Social capital* refers to the social support networks and interconnectedness that people have with others that they can draw on in times of vulnerability. *Physical capital* refers to government services such as water, sanitation and electricity, infrastructure, transport and communication facilities (DFID, 1999b; Kollmair & Gampter, 2002:6-7).

The Sustainable Livelihoods Approach (SLA) assumes that people use their assets as building blocks to pursue their livelihood strategies. When one capital is in short supply, they draw on other capitals to accomplish their goals. These capitals are also interrelated. For

instance, when a person suffers ill-health from indoor air pollution (IAP), they will not be able to go to work. This means that people who do not have secure jobs such as people working in the informal sector, domestic workers, and taxi drivers, are unlikely to get paid. In turn, this means that they cannot afford to buy nutritious food or medicine, which exacerbate their illness and prolongs the period in which they are unable to earn an income. This is what Chambers (1998) describes as deprivation traps or 'cycles of poverty'.

Another important focus, especially for this study, is the physical capital that government provides in the form of infrastructure. For the sake of the study, mention must be made of access to electricity and the financial capital that is provided in the form of the FBE and the Free Basic Alternative Energy (FBAE). As a result, *the transforming structures and processes* of government that provides the institutions, organisations, policies and legislation that provide these services to people are key to the external decision context that strengthen people's livelihood assets and their livelihood outcomes (DFID, 1999a).

Another area crucial to this study is the vulnerability context. This refers to trends and shocks that have an influence on people's lives that lie outside their control and have a negative impact on the choices they have with regards to livelihood strategies (DFID, 1999a). In the case of energy provision, issues such as load-shedding, higher electricity prices and seasonal vulnerability are relevant to mention.

The livelihood strategies of the poor then refer to the range and combination of choices and activities that they exercise to achieve their livelihood goals (Kollmair & Gamper, 2002:8). To achieve their goals, the poor engage in dynamic processes in which they combine activities to meet their needs at different times, locations, and at various levels (DFID, 1999a). Scoones (1998:10) calls these strategies their 'livelihood portfolio' where livelihood resources are combined in creative, innovative, and sometimes complex ways. The sustainable livelihoods approach shares many similarities with the ECHDE framework which forms the theoretical framework for this study and which will be fully discussed in the next chapter.

Due to the influence of prominent scholars such as Sen, the UN adopted a more qualitative approach to aid in understanding poverty and human development and to address the limitations of using wealth as a sole indicator for development (Herrero, Martinez & Villar, 2012:248). Poverty is now measured using a more qualitative approach such as the Human Poverty Index (HPI) and Human Development Index (HDI). This approach examines

longevity, knowledge, and living standards, and uses indicators such as access to clean water, health services, and the percentage of underweight children under five to gauge 'development' levels (UNDP, 2000:44).

In 2000, the United Nations Assembly Summit, also known as the Millennium Summit, adopted certain development goals known as the Millennium Development goals, which formed the centre of the United Nations and the global community's development focus. These goals were adopted by 191 heads of government and focused on health, gender equality, education, the environment and global partnerships for development (United Nations, 2000). They were revised and adopted again at the 2015 follow-up summit where they were renamed Sustainable Development Goals (SDGs) (United Nations, 2015). The need for universal energy access was not part of the original millennium goals, but this omission was rectified by this revision where its importance in development has been recognised to the degree that it has become a stand-alone goal (United Nations, 2015).

The concept of sustainable development was adopted at the World Commission on Environment and Development in 1987 where the term was coined: "…development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development, 1987:43). The concept seeks to stress the synergy and link between the social, economic, and environmental dimensions of development. As a result, the protection, conservation, and management of natural resources during the development process are seen to be vital for the future health and prosperity of humanity (UNCED, 1992).

The South African government is also a signatory of the Sustainable Development and Millennium Development Goals and has made its commitment to achieving these goals concrete in its National Strategy for Sustainable Development (NSSD). However, it must be said that South Africa, as a developing country, struggles to give equal weight to all three components of its SDGs. The country's commitment to social upliftment though, has been a priority since the adoption of the Reconstruction and Development plan of 1994. It has special programmes to assist households that are considered poor, or as the government calls it 'indigent'.

According to the South African Department of Provincial and Local Government (DPLG) (2006a:13) the concept 'indigent' refers to "lacking the necessities of life". The South African government intends to provide the most vulnerable and poor the necessary services and

‘safety nets’ to assist them to survive. Any individual who does not have access to sufficient water, basic sanitation, refuse removal in denser settlements, environmental health, basic energy, healthcare, housing, food, and clothing is seen to be ‘indigent’ (DPLG, 2006a:13). The government has operationalised the concept of ‘indigent’ as follows (DPLG, 2006a:13):

> Indigent’ means any household or category of households, including a child headed household, earning a combined gross income, as determined by the municipality annually in terms of a social and economic analysis of its area, as vested in the municipal policy, which qualifies for rebates or remissions, support or a services subsidy, provided that child support grant is not included when calculating such household income.

The operational definition of ‘indigent’ therefore does not specify a level of income as, according to the government, poverty is relative and will differ between communities and regions. It is up to each municipality to establish their own criteria for vulnerable households.

They are led by the following criteria though: households that are headed by females, receive social security, illiteracy, unemployment, level of income, household level of occupancy, and household dwelling type (DPLG, 2006b:8). In order not to fall below the internationally accepted ‘poverty line’, a South African household must not earn less than R577 a month (Gauteng Provincial Treasury, 2016:63). These householdsl fall into the lowest LSM 1 category.

2.2.2 Energy poverty

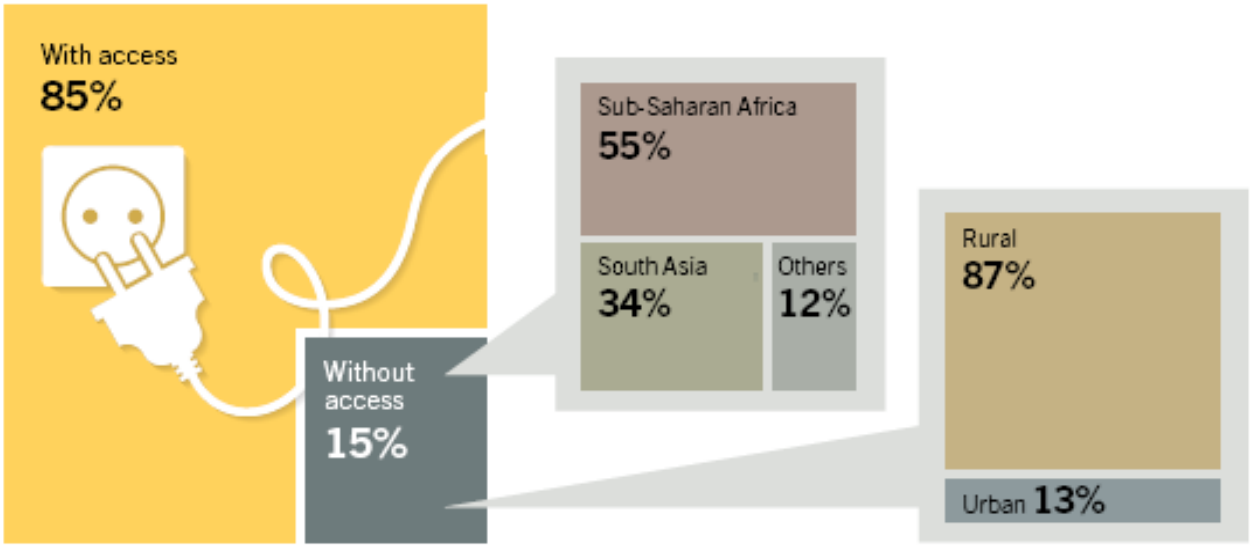
The fossil fuel revolution of the 18th and 19th Centuries in Europe was made possible by unprecedented scientific and technological innovations of this period. New technology made the efficient extraction and use of fossil fuels such as oil, coal and natural gas possible. The use of these fuels gave the world many benefits, such as increased farm productivity, more sophisticated industrial production systems, globalised trade, and the transformation of structures (Smil, 2004:557). Smil (2004:557) states that this revolution “released hundreds of millions of people from hard physical labour, improved health and longevity, spread literacy (and) allowed for rising material affluence”.

Unfortunately, these benefits where only limited to a small portion of the globe. In 2017, it was estimated that 1 billion people, or 15% of the world’s population, still did not have access to electricity (REN21, 2017:19). Many more people do have access to the grid but do not use electricity as electricity services are either unreliable and/or unaffordable (AGECC, 2010:14).

These figures on energy poverty also correlate with the global number of people who live below the income poverty line (Chaurey *et al,* 2012:48). This link between income poverty and energy poverty is also visible at regional level. Among the world's 'energy poor' almost 80 to 85% were from Sub-Saharan Africa and Asia at the beginning of the decade (Chaurey *et al,* 2012:48; Sovacool, 2012:274). Although Africa has 1 billion of the world's population, it only contributes 4% of the world's electricity output (REN21, 2015:103, 23).

At the beginning of the decade, nine out of the ten least electrified countries in the world were in Sub-Saharan Africa (Nepal, 2012:2200). In 2015, almost 620 million people in Sub-Saharan Africa, or two-thirds of the population, did not have access to electricity (REN21, 2015:103). Lack of access to electricity is also mostly a rural issue with 139 million people with no access to electricity being urban and 941 billion people being rural dwellers (REN21, 2015:103). Figure 2.2 show the proportion of world electricity access and lack of access by Region for 2012. Unfortunately more recent statistics are not available.

Figure 2.2: World Electricity Access and Lack of Access by Region, 2012



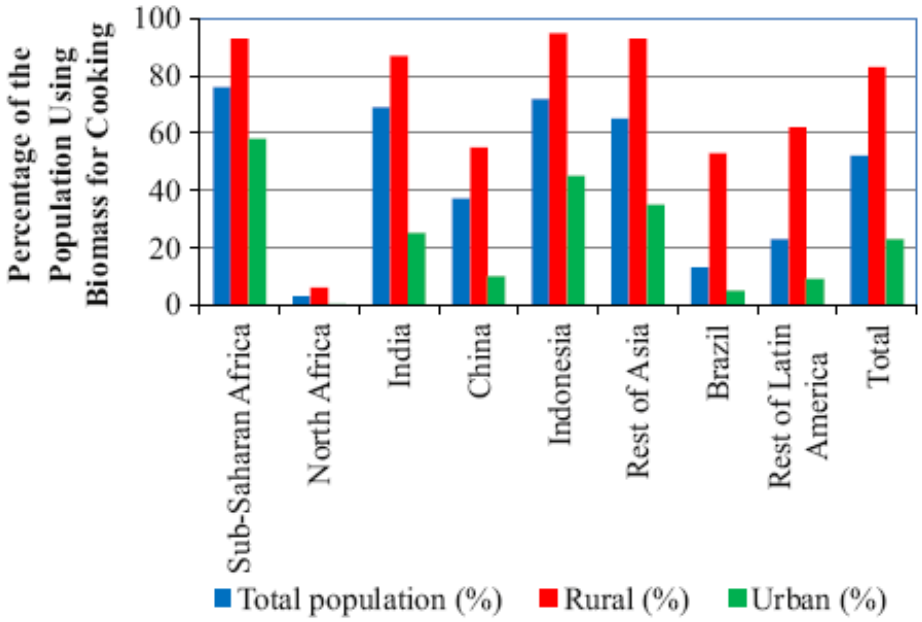
Source: REN21 (2015: 104)

The most widely used measure in the literature to gauge 'energy poverty' is an affordability or expenditure approach. In this approach, households are considered to be 'energy poor' if they spend more than 10 to 15% of their monthly or yearly income on energy (Sovacool, 2012:273). The South African Department of Energy has also adopted this approach as its official measure of energy poverty in 2013 (Ismail & Khembo, 2015:68). The United Nations (The Millennium Project, 2005:9) though, also uses the following three criteria: per capita electricity consumption, the incidence of solid *biomass* use for cooking and heating, and

"…the inability to cook with modern cooking fuels and the lack of a bare minimum of electric lighting to read, or for other household and productive activities after sunset."

Biomass consists of energy sources such as charcoal, wood, stalks, dung and other forms of farm waste. Biomass use is mostly a rural phenomenon (REN21, 2015:103) and, according to the WHO (2016b) and REN21 (2015), it is estimated that 2.9 billion people use biomass for their thermal heating purposes. Sub-Saharan Africa uses much less biomass than Asia, but it has the highest *prevalence* of biomass use. It is estimated that almost 80 to 90% of all households in Sub-Saharan Africa make use of biomass to supply their thermal energy needs (Kees & Feldmann, 2011:7595; REN21, 2015:103). Also, even though the GDP of Sub-Saharan countries have risen since 1995, the number of people without access to clean cooking energy has also risen by almost 2.7% every year (REN21, 2015:103). Figure 2.3 shows the global estimated distribution of people using biomass resources in 2006. As can be seen, Sub-Saharan countries have the highest incidence of *urban* biomass use in the world. Unfortunately more recent statistics indicating urban biomass use within this table context are unavailable.

Figure 2.3: Distribution of people in the developing world relying on biomass resources as primary fuel for cooking, 2006



Source: Urmee and Gyamfi (2014:6260) (Taken from IEA report, 2006)

Pachauri and Spreng (2011:7497), Rehman *et al* (2012:36), and Nussbaumer *et al* (2012) make the point though that considerable work still needs to be done to accurately measure household energy poverty. In practice, many variables interfere with the production of accurate statistics.

Also, just as the concept of 'poverty' can be seen in a western-centric way, there is a tendency to view 'energy poverty' in this way. The strong correlation between a country's GDP and energy access (Khennas, 2012:21) adds to this perception. Measuring energy poverty by looking at household biomass use is also demeaning for poor households. Pachauri and Spreng (2011:2498) use the example of a household that covers all its energy needs from its own abundant wood supply and use it in a good stove. According to outsiders, this household is energy poor. However, is this the case? Consequently, alternative ways have emerged in which to measure energy poverty.

The Asian Development Bank, for instance, defines energy poverty as: "the absence of sufficient *choice* in accessing adequate, affordable, reliable, high-quality, safe and environmentally benign energy services to support economic and human development" (Sovacool, 2012:273). Naussbaumer *et al* (2012) devised a metric that uses a multi-criteria framework that underpins the multidimensional nature of energy poverty. Their framework captures the complexity of the nexus between energy and human development. Their focus on quantifying energy *deprivation*, as opposed to access, takes into consideration cultural practices, and the environment of the poor. This Multidimensional Energy Poverty Index (MEPI) gives a picture of local energy poverty from the perspective of the poor.

Energy poverty is a major obstacle to human development. The UNDP (2005a:6) states: "no country in modern times has substantially reduced poverty without a massive increase in its use of energy and/or shift to efficient energy sources" and "A lack of efficient energy hampers people to escape from their poverty traps and specifically the 'circle of energy poverty'" (UNDP, 2004:2). Studies have shown a high correlation between energy use, economic growth, and the level of development of a country (Cabraal *et al,* 2005:118). Energy services brings about multiple and synergetic development impacts (UNDP, 2005a:10) and usually works in tandem with other service provisions to facilitate development. Often, many development impacts associated with energy services are indirect in nature (UNDP, 2005a:15). This also means that providing energy services is a vital but not a sufficient part of eliminating poverty. As the UNDP put it: "…when poor people and communities obtain access to convenient and efficient energy services, one major barrier to poverty reduction can be lowered or removed (UNDP, 2002:3-4). The lack of access to energy was also seen to be a major undermining factor in achieving the original MDGs (Nassbaumer *et al,* 2012:232).

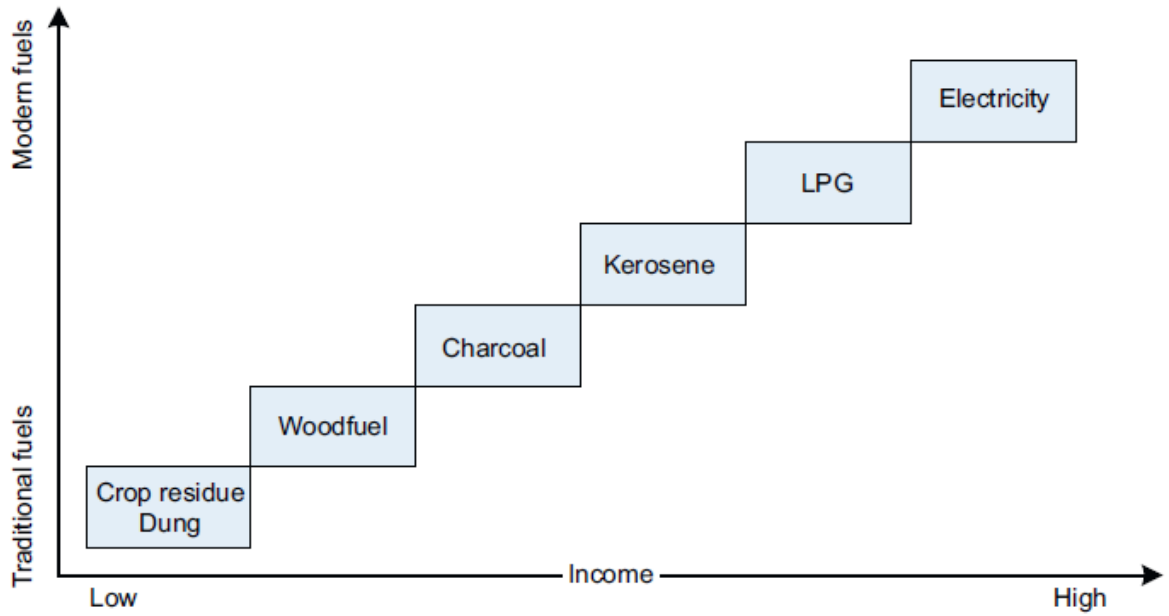
The role that energy plays in addressing poverty has mainly to do with increasing energy access, affordability and choice (UNDP, 2004:2). Energy services supply the benefits that "trigger" wider social and economic changes and create the conditions for improving social equality and economic growth (UNDP, 2004:2; UNDP, 2005b:8). At a national level, energy services form the basis for industrial growth, provide access to global markets through communication and transport, and attracts foreign direct investment (UNDP, 2005a:13). At the household level, reliable access to energy increases household living standards (Cabraal *et al,* 2005:118). Even just having access to lighting, enables the poor to extend their livelihood and production activities beyond daylight hours (UNDP, 2005a:13) and they pay less for energy as more efficient energy systems reduce unit costs. This means that they have more income to invest in other areas of their lives or to invest in capital for productive activities (DFID, 2002:27; The Millennium Project, 2005:18).

2.2.3 "The "Household 'Energy Ladder" and "Fuel stacking" theories

An organisation such as the Advisory Group on Energy and Climate Change (AGECC) uses the idea of an 'energy ladder' to measure poverty. The 'energy ladder' refers to the idea that the primary types of energy used in developing countries can be arranged on a 'ladder' with the most basic sources of energy being animal power, biomass and candles, more advanced fuels being kerosene and charcoal, and at the top of the 'ladder', electricity and liquid petroleum gas (LPG) use (Sovacool, 2012:273). People choose energy types based on comfort, affordability, ease of access, ease of use, cooking time and efficiency, and the 'cleanliness' of fuel (Van den Kroon *et al,* 2012:504)

The 'energy ladder theory' assume that poor households will naturally move 'up the ladder' to make use of increasingly modern, more efficient and 'cleaner' fuels as they become economically able to do so. Figure 2.4. Represents a simplified version of the traditional 'household energy ladder'.

Figure 2.4: The Household Energy Ladder (Simplified version)

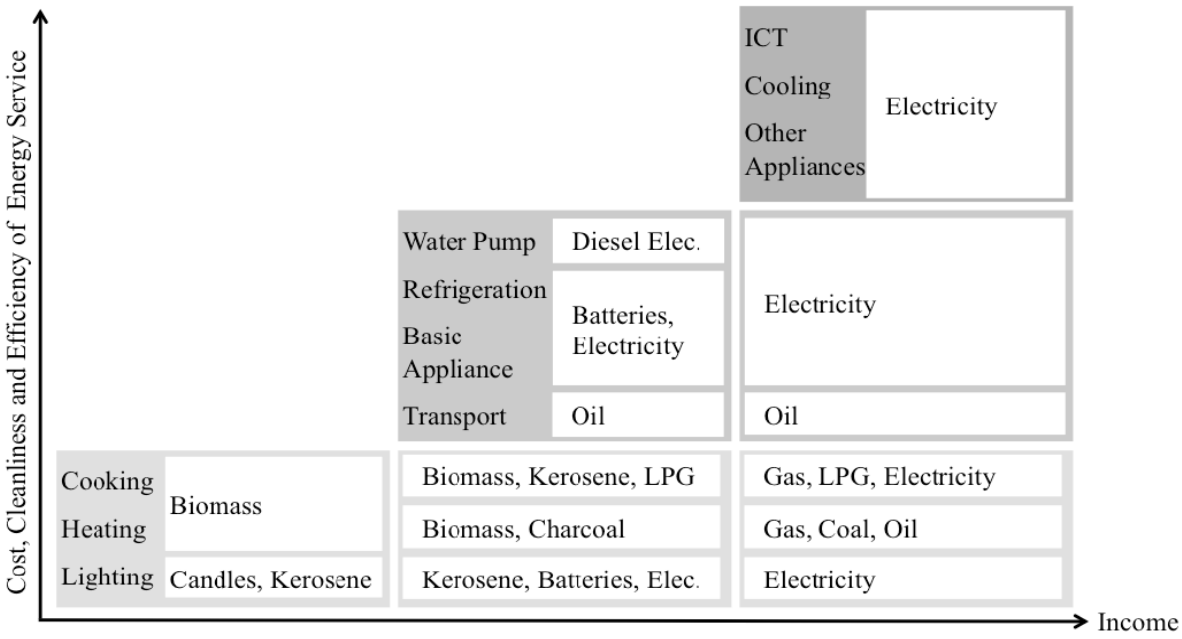


Source: Kowsari and Zerrifi (2011:7508)

Central to the idea of the household energy ladder theory are the concepts of 'fuel switching' and 'transitioning' (Takama, Tsephel, Aned & Johnson, 2012:1764). The concept of 'switching' denotes a complete displacement of one fuel with another, and does not mean the same as 'choosing' a different fuel for a specific period (Van der Kroon *et al,* 2013:505).

There are three major 'steps' in the household energy ladder theory (See Figure 2.5). At the bottom of the energy ladder, households are completely reliant on traditional fuels such as biomass and fuel wood for meeting their energy needs. As household income increases, they 'switch' from traditional fuels to using fossil fuels such as kerosene, coal and charcoal. This is seen as a 'transition' from one level of the ladder to another. The fuels on the second rung of the ladder are also called 'intermediate' fuels and are considered to be 'cleaner' and more efficient (OECD/IEA, 2006:419). As household income grows still, households 'switch' again to make use of 'modern' energy forms such as LP gas, natural gas and electricity to meet their household energy needs and so 'transition' to the top of the ladder.

Figure 2.5: The Household energy ladder



Source: Schwan (2011:6)

The central idea of the household energy ladder is that households will naturally gravitate towards using fuels that are increasingly clean and that the rate of uptake will depend on household income relative to the price of the more expensive fuel, the cost of new appliances and the physical access to, and network reliability of modern fuels (Masera, Saatkamp & Kammen, 2000:2088; Heltberg, 2004:870). In the energy ladder theory, households that use different fuels are thought to belong to different 'development levels'. The household energy ladder assumes that households will completely phase out the use of dirty and inefficient fuels such as biomass when it becomes economically possible for them to do so.

The household 'energy ladder' has come under a lot of criticism. Heltberg (2004), for instance, has conducted assessments of fuel use in rural and urban areas in eight developing countries and noted that poor households' energy use rather resembles that of a portfolio. He says: "Instead, fuel use better resembles a portfolio or menu choice in which households choose both high- and low-cost items depending on budgets, preferences, and needs (Heltberg, 2004:871)." In fact, the poor are prolific multiple fuel users.

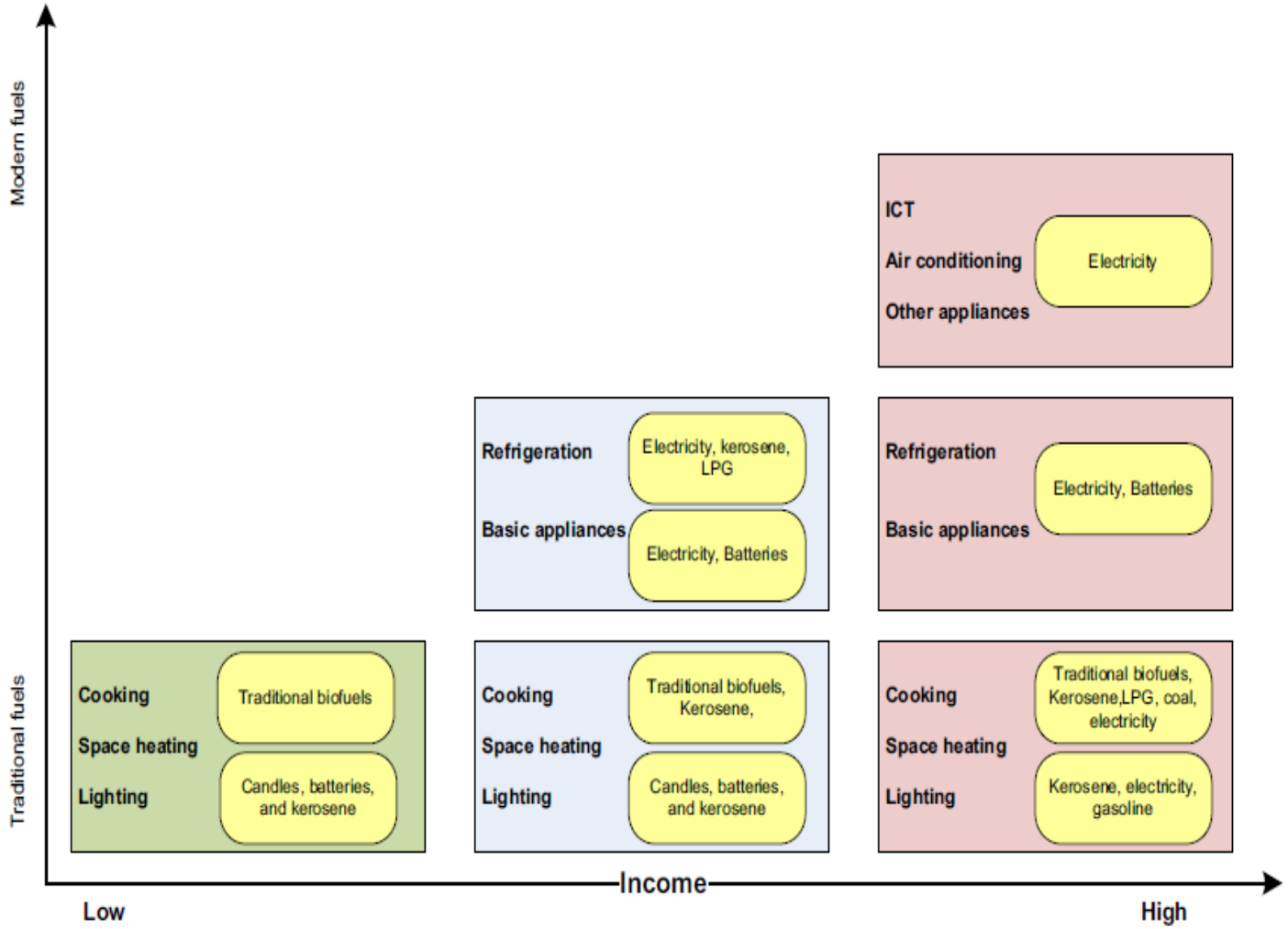
Mncube (2007:26) states that the household energy ladder theory does not sufficiently take the impact of numerous variables on people's fuel choices into consideration. These variables are, amongst others, demographic structure, educational level of the household and household head, status and ownership of the household dwelling, influences from the natural environment such as climate and the availability of natural resources.

Masera *et al* (2000:2094) also found that the extent and permanence of the incidence of multiple fuel use by poor households depends on the complex interplay between social, economic, and cultural factors. Economic factors can be high fuel prices and the reliability of supply. Social factors can be the evolution and security of household income and cultural factors are traditional habits and religious beliefs. In fact, Sole (2015:31) makes mention of a study done by Mekonnen and Kohlin (2009) which found that households tend to increase the number of fuel sources used as their income rises.

Consequently, the prevailing theory on energy use amongst the poor in developing countries is that poor people, in urban as well as rural areas, do *not* switch from one single fuel to another, but routinely make use of different fuels from various parts of the 'ladder' for cooking and heating. This theory is called the 'fuel stacking' theory (Masera *et al,* 2000:2094; Takama *et al,* 2012:1764; Van der Kroon *et al,* 2013:506). Figure 2.6 depicts the assumptions of the fuel stacking theory.

Nevertheless, Mncube (2007:20) points out that even though the household energy ladder theory is overly simplistic, studies on energy use in developing countries do indicate that households prefer cleaner and more efficient energy sources when it becomes available and affordable. Van der Kroon *et al* (2013:505) for instance, found that per capital consumption of modern fuels is high among high-income households, even though they occasionally use traditional fuels such as fuel wood. The households 'energy ladder' theory can therefore not be completely discarded.

Figure 2.6: The 'Fuel stacking' model



Source: Kowsari and Zerrifi (2011:7509)

It is not easy for the poor to move up from the bottom rung of the 'energy ladder' though, even if they can afford it. Albertyn *et al* (2012:792) say that developing countries do not have the financial, institutional, or technical capacity to extend the electric grid to their isolated and low populated areas, and private energy companies lack the incentive to provide services to low consumption populations if it is not profitable (Nepal, 2012:2201).

That is also why the International Energy Agency (IEA) predict that at least one third of the world's population will still be using biomass for cooking purposes by 2030 (Sovacool, 2012:275). Even though the share of traditional biomass dependent households will drop, the total number of people who will continue to make use of it will increase (Kowsari & Zerriffi, 2011:7505). Rural households, especially, are expected to have few choices when it comes to fuel for cooking and heating, unless they receive external assistance.

Mncube (2007:23) and Masera *et al* (2000:2094) state that there are push and pull factors at work that drive households up or down the energy ladder. Factors that pull people up the energy ladder are the advantages inherent in the use of 'cleaner' fuels. Factors that push them down are the advantage of using 'dirty fuels'.

2.2.3.1 The fuels of the household energy ladder (HEL)

(1) The bottom rung of the HEL: Fuel wood and Biomass

According to Nansaior, Patanothai, Rambo and Simaraks (2011:4185), urban households in developing countries use much less biomass then rural households and use a lot more 'modern' energy sources, but biomass continues to be an important component in their energy portfolio mix. Mncube (2007:20) mentions examples from countries that underscore the popularity of the use of biomass for urban cooking. In China's urban areas, biomass is used in conjunction with electricity. In Guatemala, fuel wood is used in conjunction with LP Gas (Mncube, 2007:20). In China, India, Nepal, Pakistan, Thailand, and Vietnam the consumption of fuel wood increased with urbanisation (Nansaior *et al,* 2011:4181). In Nigeria, fuelwood is said to be the preferred energy source amongst rich and poor households alike (Hiemstra-van der Horst & Hovorka, 2008:3336). In fact, a report by the German Federal Ministry for Economic

Cooperation and Development (BMZ, 2014) states: “cooking with wood fuels […] is so deeply ingrained in many local cultures that other fuels have little appeal.”

Van der Kroon *et al* (2013:505), and Hiemstra-van der Horst and Hovorka (2008:3334) mention that fuel wood use is popular amongst *all* income groups in the developing world, although wealthier households use it as a supplementary fuel for cooking. According to Van der Kroon *et al* (2013: 505) this discredits the household ladder theory’s assumption that the use of fuel wood is an ‘inferior’ good or ‘a fuel for the poor’. It must be noted that in many of the areas mentioned above, such as Nigeria, there is inadequate electricity access or many power outages in urban areas (Havet, Chowdhury, Takada & Cantano, 2009:33). This could be a significant factor that influence people’s fuel choices.

The use of wood and other biomass has negative consequences on people’s health and the environment. People traditionally burn wood and biomass with cooking apparatus such as three-stone fire pits, traditional mud stoves, metal, cement, pottery, or brick stoves that have no chimneys or hoods (Kshirsagar & Kalamkar, 2014:583; OECD/IEA, 2010:7). When wood and other biomass is used in insufficient cook stoves, it leads to incomplete combustion which releases particles of dangerous chemicals and gasses (UNDP, 2005c:5). As cooking often occurs indoors, these effluents are concentrated in small living spaces (UNDP, 2005c:5) and the suspended matter from emissions put people at risk for acute respiratory infections such as pneumonia and middle ear infection – this is especially true for children (Bruce, Perez, Padilla & Albalak, 2002:5,7) and chronic obstructive pulmonary disease such as bronchitis and emphysema, asthma and TB (UNDP, 2005c:4; Bruce *et al,* 2002:7).

Studies have shown that the concentration of IAP that results from the above in developing countries are sometimes sixty times that of urban centres in the developed world (Sovacool, 2012:275). This is made worse by the fact that people usually cook at the same time and, depending on the food type, spend up to three to seven hours a day cooking (Sovacool, 2012:275). In winter and in cold regions people often keep fires burning regularly indoors (Bruce *et al,* 2002:13).

Not surprisingly, it is women, the elderly, and children who are mostly affected by this, as women traditionally do the cooking, and their small children and the aged stay indoors

with them in the cooking area (Fullerton, Bruce & Gordon, 2008:849; UNDP, 2011:38). Furthermore, Singh, Gupta, Kumar and Kulshrestha (2014:1) mention that 0.5 million people also die from diseases that are caused by the smoke that emanate from polluting households. This is because when biomass smoke contacts sunlight, it undergoes a chemical change that renders it highly pollutive (UNEP, 2011:14). Bruce *et al* (2002:12) state that atmospheric air pollution not only makes the air in densely populated urban slums unbreathable; it also contaminates urban water sources. Besides death, these pollutants also cause other health problems such as cataracts (Fullerton *et al,* 2008:849) and pregnancy-related outcomes like miscarriages, stillbirth and low birth weight (Bruce *et al,* 2002:5). Low birth weight lead to ill health and increases infant vulnerability to life threatening diseases (Mishra, Dai, Smith & Mika, 2004:746).

Furthermore, Blom, Van Niekerk and Laflamme (2011:1395) say that the extensive use of open fires, through wood burning, leads to many fatal burns in the developing world. This danger is compounded in high population density urban areas. Albertyn *et al* (2012:791) says that almost 17 million children in Africa suffer from burns annually and that 18,000 to 30,000 children under the age of five die from burn injuries.

Studies in India have shown that women who collect and transport wood fuel sometimes suffer from severe neck-, back-, and headaches, and bruising (Foell, Pachauri, Spreng & Zerriffi, 2011:7489). In general, women spend up to three mornings a week collecting biomass (UNDP, 2005c:4). This varies according to the environment and the type of food that is cooked. Where the environment is much depleted, or where the prices of wood rises when it becomes a commodity (such as in urban areas), families change their eating habits to adapt to this circumstance. A study done in Malawi, for instance, found that people stopped eating food such as beans, which is nutritious, due to the long time it needs to simmer to be edible. This obviously affects people's nutritional levels and consequently their health (Kees & Feldmann, 2011:7595).

Access to energy can free up a mother's time to spend on her children's emotional, educational, and physical needs, and enable her to take advantage of prenatal health care as well as more regular post-birth visits to the clinic (UNDP, 2005a:10, 67). These factors contribute significantly to preventing the deaths, ill-health, and the effects of malnutrition in children.

Furthermore, the burning of biomass contributes to climate change. Climate change refers to the destabilisation of the delicate balance of the global climate through increased atmospheric temperatures caused by increases in concentrations of greenhouse gas (GHG) emissions (UNDP, 2010c:3; VijayaVenkataRaman, Iniyan & Goic, 2012:878). GHG consists of Carbon dioxide (CO_2), which is released during energy production and deforestation, methane (MH_4) and nitrous oxide (N_2O) which is released through agriculture and land-use change, and water vapour (H_2O) and other gasses that result from artificial chemicals (Winkler, 2005:355). The effects of these gasses are disastrous for the climate and environment. It leads to an increase in global temperatures which results in ocean acidification (through the absorption of carbon dioxide), increased frequency and severity of weather events, sea-level rise, and dramatic fluctuations in rainfall (Spalding-Fecher, Winkler & Mwakasonda, 2005:100; VijayaVenkataRaman *et al*, 2012:878; UNDP, 2010c:3). Scientists are in accord that the earth cannot afford to see a temperature rise of 2% above pre-industrial levels, and that anything above will cause irreversible damage to the earth's climate and ecosystems (UNDP, 2010c:3).

Next to the energy sector, deforestation is the second biggest contributor of global GHG emissions. In 2014, fossil fuels were only responsible for 35Gts of the 52.7Gt of CO_2 emitted. The rest was mostly as a result of deforestation (UNEP, 2015:xvi). The reason for this is that trees absorb carbon, so when trees are felled, the carbon storage capacity of the planet is reduced, resulting in a carbon increase (Kees & Feldmann, 2011:7595).

Sub-Saharan Africa has lost almost three quarters of its original forest cover (Kees & Feldmann, 2011:7595). This has been mostly because of converting forests for small-scale permanent agricultural activities (UN-REDD, 2007:3). According to Kees and Feldmann (2011:7595) though, Sub-Saharan Africa's huge demand for wood and charcoal for fuel purposes are also a significant contributor to deforestation. Apparently, almost 90% of wood removal in Africa is used for fuel. Wood fuel use in Sub-Saharan Africa is therefore unsustainable and will lead to shortages of fuel wood which will continue to add to women's burdens as they must walk far and spend a lot of time looking for fuel (UNEP, 2011:14; Kimambo, 2007:41). It will also lead to loss of biodiversity, increased soil erosion and water loss, unavailability of wood and non-wood forest products and the loss of livelihoods and safety nets for people (UN-REDD, 2007:1; Kees & Feldmann, 2011:7595).

It is thus clear from a climate change, environmental as well as human security perspective, that interventions are necessary to curb deforestation in developing countries and to assist poor people to have access to cleaner energy alternatives. Consequently, developing countries have been encouraged to adopt sustainable development policies and measures (SD-PAMs) to mitigate climate change emissions and protect their environments. SD-PAMs starts from development objectives, which aim to deliver basic services such as energy, transport, housing, health, etc., in a sustainable way. In this process, the reduction of greenhouse gas emissions is a co-benefit (Winkler, Höhne & Den Elzen, 2008:119). These SD-PAMs are an extension of countries' National Strategies for Sustainable Development (NSSD), which was supposed to be effective from 2005. This also links with international and national commitments through the SDGs to achieve environmental sustainability. Any effort to address energy poverty then, needs to consider not only the health effects of biomass and wood fuel, but also the impact that its use has on climate change, the environment and human development.

(2) The intermediate fuels: Kerosene, Charcoal, and Coal

Kerosene, which is also known as 'paraffin' in South Africa, is a popular urban fuel in developing countries. Globally, almost 1 billion households use it for lighting (WHO, 2016b:vii). It is also used for cooking and space heating. Kerosene is popular because it is cheap, it enables fast cooking and the cooking device allows the intensity of the heat to be regulated (Albertyn *et al,* 2012:792).

Although the popularity of kerosene use for lighting is known, there are many gaps in the literature about the incidence of kerosene use for cooking and space heating in developing countries (WHO, 2016b:47). However, a study by Lam *et al* (2012) compares the use of kerosene of rural and urban areas in Kenya, Nigeria, Indonesia, Nepal, Peru, and Honduras. They found that urban areas have a significantly higher incidence of kerosene use than rural areas. Nevertheless, kerosene is a controversial fuel for urban dwellers. Many experience it as unsafe and as a fire hazard and many do not like the taste of food prepared with kerosene. In fact, a study conducted by Akpalu, Dasmani and Aglobitse (2011:8) in Ghana found that kerosene was the least preferred fuel for poor urban dwellers, with LP gas being preferred. Maconachie, Tanko, and Zakariya's (2009:1094) study in Northern Nigeria shows similar results. They quote a local resident

of Kano who says: “When women try cooking for a large family on a kerosene stove, the food will not be cooked well, and it will take too much time”.

Kerosene use has been subsidised by many developing countries in the past to encourage their poor to move away from using biomass for cooking (Lam *et al,* 2012:425). Evidence from various studies though, suggest that should urban households have the opportunity and choice to use an equally cheap fuel that has the same convenience, they would rather make use of it than kerosene (Mncube, 2007:28-29; Maconachie *et al,* 2009; Akpalu *et al,* 2011).

In South Africa, kerosene is widely used by poor urban households as their *main* source of energy. At the beginning of the millennium, the country had five refineries that supplied about 800 million litres of kerosene a year to the South African public. The country also has a well-established kerosene distribution network (Mncube, 2007:13). The higher prices of kerosene after 2007 though has made kerosene more expensive and therefore less affordable to use.

Before 2010, kerosene was viewed as a ‘clean’ fuel that does not cause IAP. A study by Bailie, Pilotto, Ehrlich, Mbuli, Truter, and Terblanche (1999:585) though, found that certain kerosene devices emit a gas that causes shortness of breath, headaches and irritability, and can lead to unconsciousness and/or death. Lam *et al*’s study which was published in 2012 revealed that the gasses from kerosene burning has a high risk of causing lung infections, TB, asthma and even cancer (Lam *et al,* 2012:396). Their report created international awareness about the undesirability of using kerosene for household energy purposes.

Furthermore, many children die from accidentally ingesting kerosene because kerosene is often sold in plastic cool drink bottles by informal traders (Mehta & Shalpar, 2004:53). Accidents with kerosene stoves and lamps are also responsible for causing many devastating fires in informal settlements (Spalding-Fecher *et al,* 2005:100). According to the WHO (2010:3), kerosene lamps are also responsible for 20% of the world’s lighting–related Carbon Dioxide (CO_2) emissions. The matter emitted when kerosene is burned is also almost 100% pure ‘black carbon’ (WHO, 2016b:49). In 2014, the WHO (2016b:4,

x) published a document requesting governments to stop the promotion and subsidy of kerosene for household energy use.

Charcoal is a convenient fuel that is used extensively in the urban areas of Africa (WHO, 2016b:41). According to the BMZ (2014:24) the global production of charcoal was around 47 million metric tonnes in 2011 and has steadily grown since then. Almost 80% of this is used by households for cooking and heating. Zulu and Richardson (2013:127) state that 80% of all urban households in Sub-Saharan Africa use charcoal as their main source of energy for cooking. In many parts of Africa, charcoal is cheaper than kerosene and LP gas (BMZ, 2014:28).

The huge urban demand for charcoal in many parts of Sub-Saharan Africa is causing widespread deforestation and environmental destruction (Foell *et al*, 2011:7489). An example is Tanzania, where in 2007, 575,000 hectares of forest was felled annually to keep up with urban demand for charcoal (Kimambo, 2007:41). In Central Africa, almost 100% of urban households in Chad relied on charcoal in 2008 (Hiemstra-van der Horst & Hovorka, 2008: 3336). In fact, charcoal is so popular that Zulu (2010:3717) predicted in 2010 that the consumption of charcoal in Africa would double from 2010 to 2030.

Charcoal derived from wood is generally seen to be a cleaner fuel than traditional biomass and has even been put on the second rung of the energy 'ladder'. Nevertheless, a study by Taner, Pekey and Pekey (2013:80) reveals that charcoal releases respirable suspended particles and carbon monoxide (CO) when it is burned. This is toxic and can cause inflammation, heart, and lung diseases, DNA damage, and it has negative effects on human respiratory, circulatory, and cardiovascular systems. A report by the BMZ (2016:29) also adds asthma, lung cancer and low birth weight in infants to this list.

Coal is a solid organic fossil mineral, rich in amorphous carbon and is found in huge deposits in various countries across the world in the form of hard coal (anthracite), soft coal (bituminous), brown coal (lignite) or peat (Kaushik, 2005:13, 3-4). Coal is extracted through either surface mining, or underground mining and is then converted either through gasification, liquefaction, slurry, or carbonisation (Kaushik, 2005:5). The power generated from coal is relatively cheap, but it is pollutive (due to CO_2 emissions), and the particulate material, and oxides of sulphur and ash in the exhaust gasses which is

released when coal is burned, pollutes water and land, and causes ill health (Khalid & Junaidi, 2013:253).

Coal use is popular amongst poor rural and urban populations in Iran, North Korea, China and South Africa as they are the world's main coal producing countries and people have easy access to coal. Coal burning for cooking purposes is pervasive in the South African provinces of Gauteng, Limpopo, and Mpumalanga (Mncube, 2007:12).

Coal is cheap in South Africa and is mostly used by poor households who are not connected to the grid or who cannot afford electricity. Merchants purchase coal from the mines and then distribute it to poor urban households (Mncube, 2007:12). They then use it in an *imbawula,* also called an *mbaula or imbuala, which* is a type of brazier (cast iron container) without chimneys or hoods (Mncube, 2007:12). Studies find that almost 50% of South Africa's urban households that live close to coal fields, use coal to warm their spaces in the winter, even if they have an electricity connection (Mncube, 2007:12). This is disturbing, as studies find that coal fires produce smoke that contains pollutants like lead (Pb) and sulphur dioxide (SO_2) which lead to arsenic (As) poisoning (Albertyn *et al,* 2012:792). It also produces carcinogenic substances that can lead to lung cancer (Brunekreef, 2010:6663; UNDP 2005c:4). Studies in townships in South Africa show that where coal is used extensively, high incidences of respiratory tract illnesses exist.

(3) The top rung of the HEL: Liquid Petroleum gas, electricity, and solar energy

Liquid Petroleum gas (LPG) is derived from natural gas, which formed millions of years ago when plant and animal matter decomposed to form underground gas fields. Natural gas consists mostly of methane (CH_4) (Kaushik, 2005:9), but the propane (C_3H_8), butane (C_4H_{10}) and pentane (C_5H_{12}) components of natural gas are removed and sold as LPG (Kaushik, 2005:15). Natural gas can be easily transported through a pipeline and is mostly used for home cooking, heat, industrial processes, and electricity generation. Natural gas is the cleanest of the commercial fossil fuels (Kaushik, 2005b:9) and has the highest combustion efficiency, energy density, and heat-transfer efficiency. Although LP gas is a fossil fuel, it does not emit many pollutants and is generally seen as a clean fuel (BMZ, 2014:2, 33). Globally, LP gas is used mostly in Asia (especially India and China) and North Africa, and it is ordinarily mostly available in urban areas (BMZ, 2014:34).

The study by Nansaior *et al* (2011:4185) in Thailand shows a direct correlation between increased urbanisation and the use of LP gas. Studies by Akpalu *et al* (2011:8), and Budya and Arofat (2011:2583) also show that LP gas is the preferred fuel for cooking amongst urban households in developing countries. Apparently, people prefer cooking with LP gas because the technology is easy to use, people feel safer when they cook with it, their kitchens are cleaner, and they can cook faster (Budya & Arofat, 2011:2583).

Nevertheless, LP gas is expensive as it is seldom sold in small quantities. Households that earn money on a daily or weekly basis can therefore not afford it. The start-up costs for using LP gas is also high. As a result, the very poor cannot afford it and those who can afford it, use it sparingly and mostly for quick cooking such as for water boiling and frying. As the supply is also irregular, households must also stock it in bulk in case they run out of supply (BMZ, 2014:3-4). Despite the above, LP gas is used by many poor urban households in the developing world because their governments subsidise it, as it is the 'cleanest' energy fuel option. As the WHO has warned governments against the subsidy of kerosene, the expectation is that many poorer urban households in developing countries will be using LP gas for cooking and heating in the future (IEA, 2017:94-59).

Access to electricity is a pivotal factor that alters patterns of multiple fuel use. According to Groh (2014), electricity is an important asset that can mitigate household energy poverty, as there is a direct correlation between electricity access as an added 'asset', and lower relative energy expenditures. According to him, households on the same income level spend more money on fuels if they do not have an electricity connection and they have a higher chance of falling into a 'poverty trap'. He calls this phenomenon the 'energy poverty penalty' (Groh, 2014).

Van der Kroon *et al* (2013:511) state that access to electricity tends to change the rural *status quo* and is an important driver for multiple fuel use in rural areas and 'switching' in urban areas. Studies have shown that electricity access in rural areas *increase* the incidence of multiple fuel use as households that receive electricity also begin to use other fuel sources such as kerosene. Van der Kroon *et al* (2013:511) explains this link between electrification and multiple fuel use in rural areas as follows: when people gain access to electricity they have a greater tolerance for using more modern fuels and when electricity become available in rural areas, it often goes hand in hand with an increasingly

diversified market with access to other modern fuels. The same phenomenon can also be observed in urban areas, with the difference that households in higher income categories have a greater propensity to 'switch' completely from using a specific energy type to using another for cooking and heating (Van der Kroon *et al,* 2013:511).

Electricity is the cleanest form of household energy besides LP gas. Nevertheless, South Africa's national electricity supply is dominated by coal, which contributes 70% of the country's primary energy and fuels 93% of electricity production. Energy supply is therefore CO_2-intensive. Much of the coal that is mined is of a low quality, and so needs to be beneficiated (Winkler, 2006:4). South Africa is one of the highest emitters of GHGs in Africa. It ranked as the world's 14th-highest CO_2 emitter from fuel combustion in 2000 and the 19th most carbon-intensive economy. Extending the grid with coal-fired energy thus contributes to its rising GHG emissions. Consequently, the production of electricity through energy inefficient environmentally polluting coal fired plants, is not in line with the country's commitment to the Paris Agreement under the United Nations Framework Convention on Climate Change (United Nations, 2015) which puts increasing pressure on the South African government to honour its national climate change policy commitments (Winkler, 2016). This need to be kept in mind when pondering solutions to household energy poverty in South Africa.

Traditionally, solar energy has not been an energy source on the household 'energy ladder'. As it is the cleanest of all energy sources though, it deserves mention. According to the UNDP's Initiative for Sustainable Energy (UNISE) (UNISE http://humaninfo):

> If the energy services are to be available for human, social, and economic development without accelerated environmental degradation and accentuated health impacts, a fundamental change is required in the manner that energy issues are integrated…This change involves a move to sustainable energy services, including renewable energy, energy efficiency, and cleaner conventional fuels.

Consequently, the UNDP focuses its energy programmes on off-grid energy solutions to provide energy to the poor in developing countries. Note that this focus is mostly for rural areas. The assumption of the International Energy Agency (IEA) was that in principle, all global urban and peri-urban households could and should be connected to the grid by 2015 (OECD/IEA, 2010:23).

Studies have shown that the positive contribution of electricity to the HDI is strongest for the first kilo-watt hour, meaning that a large portion of poor people's basic needs can be met with just a minimum supply of energy (Chaurey & Kandpal, 2010:2266). Accordingly, authors like Chaurey and Kandpal (2010:2266) state that a definite case can be made for the place of renewable energy in meeting poor household energy needs. On the other hand, studies done by Prasad and Visagie (2006:6,13) show that households that receive Solar Home Systems (SHS), continue to make use of fuels such as wood and kerosene as the power generated through the SHS technology is insufficient to meet household needs for cooking and space heating. Four types of solar technology are applicable (but not always available) to assist poor urban households to meet their household energy needs: solar photovoltaics (PVs), solar lighting, solar cookers and solar geysers.

In 2001, the South African government launched a non-grid electrification programme to address the electrification backlog in rural areas (DoE, 2015:106). This took the form of installing Solar Home Systems (SHS), which consists of solar PVs that supply between 50 to 100W of power. In 2012, this was changed to provide a minimum of 100W (DoE, 2015:106). This is enough power for lighting and some media access and the programme runs in conjunction with the roll-out of the Free Basic Alternative Energy (FBAE) programme in these areas (DoE, 2015:107-108). Note that this applies to rural areas only. In urban areas, poor households are dependent on the market to access solar PVs. Some NGOs that focus on supplying green technology to the poor, run projects to supply affordable SHSs to residents of informal and urban settlements where there is yet no electricity supply.

Because of the focus on SHS, where access to lighting is one of the benefits of this technology, there is gap in international or national studies on the sale and use of different types of solar lighting technology to the poor. An internet search though, reveals an incredible number of small non-government organisations (NGO's) and 'green' businesses that focus on marketing and retailing solar lamps to the poor. The most popular solar lighting device is the solar-powered light-emitting diode (LED) lamp (The Economist, Lighting the way). According to The Economist (Lighting the way) these solar lamps are now available in most developing countries and even the most basic solar lamps perform much better than the ubiquitous kerosene lamp. A typical solar lamp

takes about eight to ten hours to fully charge in the sun and provide up to five hours of bright light. The battery of most solar lamps lasts for a long time, and most devices are quite hardy and can cope with water, dust, and rough handling. The price of solar lamps is also relatively low, and the prices are continuously falling (The Economist, Lighting the way).

There is little literature available on the impact of solar cookers to meet poor urban household needs. Solar cookers are devices with reflective surfaces that converts sunlight to heat and then conducts it into an insulated cooking space, which houses the cooking pot (Kimambo, 2007:42; Saxena, Varun, Pandey & Srivastav, 2011:3301-3302). There are two main types of solar cookers: solar cookers with the ability to store thermal energy and those which cannot. The latter is most commonly available commercially.

The most often quoted solar cooker project in international literature is a study conducted in South Africa in the 1990s. The project made use of two types of solar cookers that do not have the capacity to store energy, namely the standard box-type cooker, and parabolic cookers. The study revealed that these cookers had a beneficial impact on the reduction of using energy fuels by the households in the study. They used 38% less fuel (wood, gas and kerosene) after being given this technology. It also enabled labour time savings of between 36% to 44% for the households, as women and children did not have to spend a lot of time looking for wood and other biomass material for cooking purposes (Biermann, Grupp & Palmer, 1999; Wentzel & Pouris, 2007). Also, it increased the household energy mix and enabled households to use less ‘dirty’ fuels for cooking (Biermann *et al* 1999).

Other studies with solar cookers also reveal many more benefits. Food prepared with a solar cooker taste and smells good and is highly acceptable to its users (Sengar, Dashora & Mahavar, 2010:1041; Panwar, Kaushik & Kothari, 2012:3781). Its use results in meals which have a higher nutritional value and are more hygienic (Muthusivagami *et al,* 2010; Sengar *et al,* 2010:1041). It enables families to cook certain staple foods such as beans, soup, ‘samp’, and maize porridge (‘pap’) which require long cooking times and normally use a lot of biomass (Wentzel & Pouris, 2007; Sengar *et al,* 2010:1041). It enables financial savings, which mean that more money can be spent on

other things such as transport, better quality food such as vegetables and meat, and cleaner energy sources. Solar cookers do not need a lot of attention whilst in use which means that cooks, which are normally women, have more time to spend on other things (Wentzel & Pouris, 2007). They are durable if used correctly (Muthusivagami *et al,* 2010; Yettou *et al,* 2014:288) and a simple solar cooker is less expensive to run over the long term than cooking with LP gas and kerosene (Sengar *et al,* 2010:1042).

Nevertheless, solar cookers also have their drawbacks. Firstly, one cannot regulate temperature during cooking (Yettou *et al,* 2014:288). The effectiveness of the cooker depends entirely on the availability of sunlight. Even the appearance of dispersed clouds can affect the internal temperature of the cooker (Muthusivagami *et al,* 2010:691). People who live in urban areas who go to work during the day are unlikely to leave their food and cooker outside unguarded (focus group discussion) and certain cookers such as the parabolic cookers are big and unwieldy, and people are not able to bring it indoors to store. Most importantly, solar cookers that do not have heat storage capacity, can reduce reliance on traditional fuel, but are unable to completely replace it (Biermann *et al,* 1999).

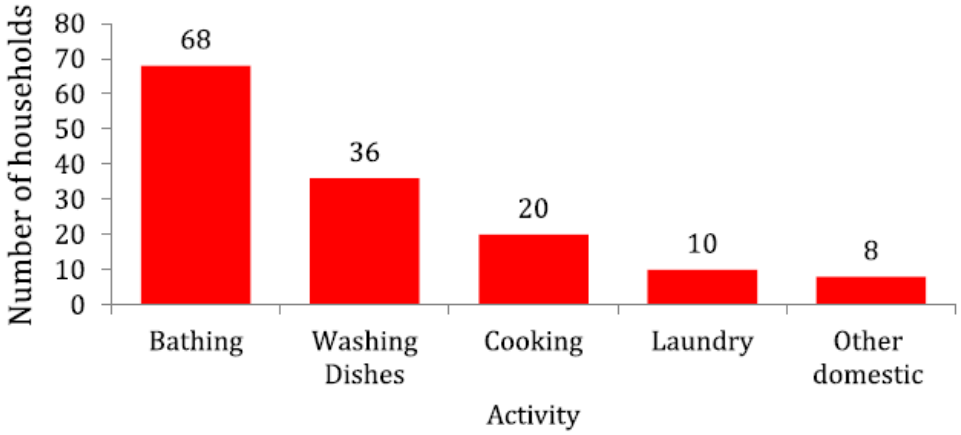
The impact of solar cookers that can store energy has not been tested or rolled out in a community for study purposes, but a purely technical study done by Cuce and Cuce (2013:1415) reveals that these cookers can be used more than once a day, they can be used late at night and the temperature can also be regulated. These cookers have therefore tremendous potential to meet poor household need for cooking. In 2007, though, they were expensive (Wentzel & Pouris, 2007:1912). It is unclear from a literature review how affordable or available they are today.

South Africans spent about 5% of the country's electricity supply on residential water heating. In fact, the average home in South Africa spends about 40 to 50% of its electricity bill on water heating alone (Curry, Chernie & Mapako, 2017:75). Solar water heating systems (SWH) can therefore save an ordinary household a lot of money on its monthly electricity spend and at the same time reduce national CO_2 emissions by 5% (DoE, 2015:110). Note, however, that these savings will only relate to SHS use in the summer, as most commercially available solar heaters are not very effective in the winter.

Since 2009, the DoE developed a renewable Energy Market Transformation programme and a national Solar Water Heating (SWH) framework with the aim of lessening energy poverty, reducing CO_2 emissions and to lower electricity consumption during peak hours (Curry *et al,* 2017:75). The target was to provide five million households with SWH installations by 2030. The programme had two target populations: firstly, middle class homes where the target was to replace 100,000 GWh of power generation with SHS. As these consumers are the highest consumers of electricity through water heating, this makes sense. Secondly, 'indigent' households was to receive low-pressure SWH. The focus on this second group was to assist households that has been registered as indigent, have an electricity connection and receive RDP houses (Curry *et al,* 2017:75; DoE, 2015:111).

By 2015, the programme had installed 407,463 of SWH of which the majority, namely 35%, was installed in Gauteng. According to the DoE (2015:113), the installation of a SWH in a poor household saves the household approximately R 300 a month (2015). A study conducted by Curry *et al* (2017) reveals that, prior to SWH installation, households would use their kettle to heat water for bathing and for washing dishes. Some households reported that they would boil their kettle as much as eight times in the morning to have enough water to take a bath. The average units of electricity that would be spend on boiling the kettle amounted to 92kWh per month. After receiving the SHW, 90% of household in the study reported savings on their electricity bill. Some households even reported savings of up to 50%. The average electricity savings was 62kWh/month which is 27% of the average household expenditure on electricity. Figure 2.7 illustrates the use of the SWH after installation. Note that the amount of water used for cooking is low. This is because the recipients where never informed that the water was suitable for cooking and drinking purposes. According to Curry *et al* (2017), this confusion could possibly have been avoided if the system was installed in the kitchen instead of the bathroom.

Figure 2.7: The impact of a solar water heater on water usage (2011 project)



Source: Curry et al (2017: 80)

The installation and use of SWH's in Curry *et al*'s study (2017) show an increase in living standards for the beneficiaries. Households now had convenient access to hot water for bathing, cooking, and laundry. Half of the households in the study reported that they spend the savings that they accrued using the SWH towards buying more food. A big contribution of the SWH was also the fact that it saved people time to heat water (Curry *et al,* 2017:82). As will be seen in Chapter 6, heating water with wood and kerosene takes a long time. Many households also heat their water in containers in the sun on a hot day and then carry the heavy container inside to bath at night. This is back-breaking work. In fact, the only negative result of the project was that some households complained that their water bills were now too high (Curry *et al,* 2017:80).

Nevertheless, the DoE's SWH programme has been beset with problems. This had mainly to do with the department's insistence on using local suppliers and components. Some of the contractors did not meet agreed upon targets, had no proper maintenance plans in place to fix faulty geysers and some of the technology was inferior (EE Publishers).

In 2015 the DoE again recommitted itself to achieving its goal of installing 1.25 million systems by 2019. These SHW would be for the benefit of 'indigent' households and would still be at no cost to the beneficiaries although some systems were only to be

partially subsidised. It was also decided that the quality of the SHW technology would be tested by the South African Bureau of Standards (SABS) (EE Publishers).

2.3 Conclusion

This chapter discussed basic concepts relevant to household energy use. It firstly defined the concept of 'poverty' and 'basic needs'. It also looked at the concept of 'sustainable development' and the 'sustainable livelihood approach' to development. It was seen that energy is an 'asset' that builds up households' 'livelihood capitals' and assist them in their strategies to achieve higher living standards. The point was made that access to energy is essential for national development and increasing poor household's living standards.

The international context of energy poverty was discussed but specific reference was made to the prevalence of biomass use in sub-Saharan Africa. It was also seen that Sub-Sahara has the highest incidence of biomass use by urban households in the world. The discussion then explained the dominant theories of energy use by the poor in developing countries. The household energy ladder theory was explained as well as the critique against this theory. It was also understood that even though poor households do not move up a unidirectional 'energy ladder', there is a tendency by poor households to prefer to use cleaner and more efficient energy fuels when it becomes possible for them to access and afford to use it.

Thereafter, this chapter looked at the individual fuels of the 'household energy ladder'. The first fuel that was discussed was biomass, which includes fuel wood and organic matter such as dung and straw. It was seen that these energy sources produce dangerous pollutants during combustion which endangers health and has a negative impact on the global climate. It was also seen that the indiscriminate use of wood fuel for energy purposes was not just hampering carbon sequestration but has a detrimental impact on the environment which increase the vulnerability and hardship of the poor.

The fuels kerosene, coal and charcoal were also discussed. Even though these fuels had been placed on the second rung of the 'household energy ladder' as fuels that are more desirable and cleaner than biomass, the results of the discussion showed that the use of these fuels are dangerous and hazardous to people's health and safety and that it has an equally negative impact on the environment and climate change.

Lastly, this chapter focused on the ‘clean’ energy sources – LP gas, electricity and solar energy. It was said, that although electricity is a non-polluting household energy source, its manufacture in South Africa is not and that policies that aim to alleviate energy poverty at the household level should take this into account. The benefits of LP gas and solar energy was also discussed as well as the factors that impede their usefulness.

The next chapter will look at the Energy Choice Household Decision Environment which is a framework that has been developed to better understand the choices people make towards the energy they choose to use. It will become clear from the discussion that this environment is dynamic and are influenced by a household’s assets, culture, their natural environment, markets and the external environment of government policies and programmes.

CHAPTER 3
THE ENERGY CHOICE HOUSEHOLD DECISION ENVIRONMENT

3.1 Introduction

This chapter explores the use of the energy choice household decision environment as a framework as well as the key issues that influence energy decision-making amongst the urban poor. The theoretical framework for this study is the 'energy choice household decision environment' (ECHDE). This framework was adapted from one used in a study conducted by Bruntrup and Heidhuse (2002), by Van der Kroon, Brouwer and Van Beukering (2013). It explains the factors that influence household decision making in terms of energy strategies.

Mncube (2007:28) states that poor urban dwellers are motivated by two key issues in their choice of fuel and appliances – *price* (affordability) and *availability*. The BMZ (2014:15) and Hiemstra-van der Horst and Hovorka's (2008) studies also reveal an important third and fourth factor, namely *acceptability* (taste of food, cultural preferences) and *convenience* (can be used to satisfy multiple household energy needs). The recognition and inclusion of the first three factors (price, availability, and acceptability) in the ECHDE framework are discussed in this chapter. Unfortunately, the framework does not make sufficient provision for the factor of convenience. This factor, as well as the issues of 'status' and 'energy vulnerability' is discussed in 3.5 below.

Furthermore, this chapter looks at the 'external decision' environment of the ECHDE by looking at South Africa's national policies for electrification and energy subsidies. Finally, general trends with regards to multiple fuel use by the poor in the country is discussed to put the household energy use by the residents of Soshanguve into a broader national perspective.

3.2 The Energy Choice Household Decision Environment (ECHDE)

As detailed in Chapter 1, this study uses Van der Kroon *et al*'s ECHDE concept to investigate the factors that influence households' decision regarding energy use (see Figure 1.2 on page 14 for the general conceptual framework for the ECHDE). As was mentioned, the

ECHDE shows many similarities with the sustainable livelihoods framework of Scoones (1998). Note the components of the three spheres of the HDE and the list of determining indicators for each in Figure 3.1.

Figure 3.1: List of Indicators for the ECHDE

Household opportunity set

Human capital
Education (respondent)
Education (spouse)
Household size
Household size squared
Share of females in the household

Wealth and income indicators
Indoor water
Number of rooms in house
Ownership of dwelling
Type of dwelling
Cooking facility (external)
Household income
Household expenditure
Square of per capita expenditure

Other household characteristics
Age
Age of the Spouse
Sex of the household head
Household labour activities

Cultural background and food preferences
Religion of the household head
Social group
Indigenous
Frequency of cooking Tô
Frequency of cooking Rice
Category of food prepared

External decision context

Access to fuels
Electricity
Community distance to firewood
Difficulty of collecting firewood

Fuel prices
Wood price
Charcoal price
Kerosene price
Electricity price
LPG price
Ratio of unit price of kerosene and electricity

External environment

Location
Time

Source: Van der Kroon et al (2013:510)

As the figure shows, the innermost sphere of the ECHDE consist of the 'household opportunity' set. This is similar to the livelihood 'assets' or 'capitals' of the SLA. Four

subcategories in this category are important in the ECHDE: the household's *human capital* (education, household size, gender), *financial capital* (wealth and income indicators), the *social capital* of the household (cultural background, religion, and food preferences) and, finally, other demographic factors such as the age or sex of the head of the household.

The sphere surrounding the household 'opportunity set' is the 'external decision context' of the household/community. In this category, factors such as the availability of and access to electricity and other energy sources as well as the pricing of different energy sources are important.

The outer sphere or external environment of the ECHDE relates to the position of the household within the country's borders. In this regard, the ECHDE of households can differ as a result of where they are situated (urban/rural environment, or cold/warm climate). This sphere therefore relates to the impact that nature, geographic location, history (e.g. colonialism, apartheid), state infrastructure and services and the international economic system has on a particular household's ECHDE. As such, each household's ECHDE is unique, although households in the same communities or neighbourhoods can be expected to share many similarities in their ECHDEs.

3.3 The household 'internal opportunity set'

3.3.1 Financial capital

The matter of household income is the most important determining factor of household fuel 'switching' in the energy ladder theory. Nevertheless, its importance as a driver for energy decision-making has been questioned by those who support the fuel-stacking theory. For instance, households that earn a monthly salary would be more inclined to buy LP gas than those who do not, as this is an expensive bulk purchase. People who earn sporadically will rather use an energy source that they can find from their natural environment or buy cheap fuel in small quantities such as kerosene (Van der Kroon *et al,* 2013:508-509). The way in which income is earned is therefore an important determinant in the HDE.

House ownership is also an important factor. People who rent will not invest their own capital in adapting a house to accommodate their own choice for cooking. Van der Kroon *et al*

(2013:509) mentions that tenants are often restricted by occupancy rights regarding the energy they use, such as a prohibition on burning firewood.

3.3.2 Human capital

The quantity and quality of labour that are available in a household are important determinants in the HDE. Big households tend to use fuel wood as there are sufficient members that can be tasked with gathering it. Larger households also have a higher income burden, which influences fuel choice in favour of cheaper fuels as they will have a higher need for energy. The reverse is true for smaller households (Van der Kroon *et al,* 2013:509).

Furthermore, the education level of the occupants of a household also has a direct impact on the fuels they prefer to use, as higher levels of education are assumed to go hand in hand with an increased awareness of the health impacts and dangers of using 'dirty' fuels (Van der Kroon *et al,* 2013:509). Sole's (2015:183-184) study in Soshanguve for instance, showed that women are highly aware of the dangers of using coal and kerosene and the consequent effects of IAP. Most of these women have had some secondary education. As a result, many of the participants in the study use their wood and kerosene stoves *outside* their dwellings and only bring it inside once it had stopped smoking (Sole, 2015:184). Most of the respondents indicated that they would prefer to use 'cleaner' energy sources if they could afford it, but electricity was only affordable for some to cook light meals and to power certain appliances like the television (Sole, 2015:183-184).

Gender composition is also an important determinant of household's energy use. As women are often responsible for the laborious, time-consuming duty of collecting fuels for cooking, they often favour energy sources that can improve their living standards and save time if availability and affordability allows. Wickramasinghe (2011), for instance, observed in his study on multiple fuel use in Sri Lanka that there is a direct correlation between 'cleaner' fuel use in poor urban areas and the employment status of urban women. Women who are employed, have less time to cook and as a result select food items and meal plans that do not require long cooking times. As they use less cooking energy and earn their own income, they prefer to pay for the 'cleaner', more expensive energy sources (Wickramasinghe, 2011:7571). Nevertheless, Van der Kroon *et al* (2013:509) cite the authors Mekonnen and Kohlin (2008) who make the point that female headed households are amongst the poorest

households in many societies and are generally therefore constrained in their choice of energy (Van der Kroon *et al,* 2013:509).

3.3.3 Social capital (Culture and tradition)

Culture is an important part of the social capital component of the ECHDE. For instance, modern cooking technology does not always enable people to replicate traditional recipes, and the taste of the food produced with new technology is not always to people's liking (UNDP, 2002:8; Kshirsagar & Kalamkar, 2014:595). Women like to keep to cooking techniques that they learned from their mothers. Mncube (2007:21) mention the example of wealthy households in India and Mexico that continue to make use of traditional wood fuel stoves to prepare certain traditional carbohydrate-based dishes even though they can afford to cook with modern stoves.

In their study of urban households in Maun, Botswana, Hiemstra-van der Horst and Hovorka (2008) found that multiple fuel use amongst urban dwellers are directly linked to their cooking habits and are not used as energy substitutions. In their study, households use specific fuels to cook specific types of foods. Almost 68% of fuel wood users use wood to prepare traditional foods such as hard beans, 'samp' and 'seswaa' – local dishes that need a long time to simmer. Gas was used for preparing store bought foods such as tea, pasta, rice, small pieces of meat, etc. Respondents indicated that they chose wood not just because it was *affordable,* but because they preferred the *taste* of food prepared with wood. Hiemstra-van der Horst and Hovorka's (2008:3342) conclusion was that "modern fuel uptake largely complements fuel wood rather than leading to its abandonment".

Sole's study in Soshanguve also found that certain fuels have deep cultural and historical meaning (Sole & Wagner, 2016:5). This is especially the case with wood fuel. One inhabitant says:

> It's a way of practicing old ways of doing things and it is a cultural heritage that should be preserved. [It reminds me of] weddings, parties, funeral ceremonies at the villages…people coming together around the fire outside and taking turns to check the pots (to specifically stir the pap [maize dish]) while having conversations. This thing [burning wood] goes back to where we come from (Sole & Wagner, 2016:5).

Knowledge of suitable firewood trees is also passed down from generation to generation and stems from the participants' rural heritage. One participant revealed that a knowledge of suitable firewood trees was learned during her youth when she was living in a rural area and it assists her now to know which trees to cut down. She says; "if the tree itself smells, it will usually make your cooked food smell…some of them (trees) will create poison in the food' (Sole & Wagner, 2016:5). Another participant says;

> Once you cook using firewood, you will be satisfied with how the food will be cooked. [Maize meal (pap) is cooked with wood fuel because] it's delicious … tastier than if one cooked it with electric stove … indeed it tastes different … it comes out nicely and you will eat it I tell you. Those who grew up in rural areas can be able to differentiate the taste difference on the pap which is cooked using firewood or on the electric stove (Sole & Wagner, 2016:7).

Nansaior *et al*'s (2011:4187) study in Thailand also found that urban households prefer to use firewood or charcoal to steam glutinous rice, which is a staple food, but preferred using LP gas for quick frying of meat and vegetables. Charcoal was preferred for preparing certain slow roasting dishes. Matinga (2010:246) noted in her study of energy use in two rural villages in the Eastern Cape, that activities such as collecting firewood and cooking are meaningful to women beyond just providing for their family's needs. These activities are often an opportunity for women to socialise and is part of their identity as 'good women'. These women are also fearful that the community and other women – especially – will perceive them as 'lazy' if they switch to modern cooking appliances such as an electric stove (Matinga, 2010:249). As Bailis, Cowan, Berrueta & Masera (2009:1694) put it: "(The kitchen)…is a complex social space that is both critical to the material well-being of the household and imbued with deep cultural meaning..."

3.4 The 'external decision context'

3.4.1 Accessibility

According to Van der Kroon *et al* (2013:507) poor households in a developing country will first try to satisfy their energy needs from their own subsistence environment and then turn to the market for what they cannot supply themselves. In rural areas, biomass provides a free source of energy (Wickramasinghe, 2011:7570). In urban areas though, households are often times c*ompletely* dependent on the market. (Van der Kroon *et al,* 2013:507;

Masera *et al,* 2000:2088). This is an important distinction between the HDE of rural and urban households.

The UNDP (2002:8) mentions that urban dwellers are closer to the major energy markets and therefore have a greater *choice* of different energies and appliances than rural dwellers. Nevertheless, one must take into consideration that this access is limited by the affordability of the energy sources and appliances. In a study focusing on energy poverty in Latin America and the Caribbean, the Economic Commission for Latin America and the Caribbean (ECLAC) (2009:15) found that the poor in urban areas were, in many respects, worse off with regards to energy access than those in rural areas, as they do not have the ready access to free biomass that rural people do. Also, according to the writer Sovacool (2012:273-274):

> …the poor in urban areas face special problems in meeting their basic energy needs…they pay higher prices for usable energy because of the inefficiency of stoves and lamps and ...(they) continue(s) to rely on traditional fuels they collect on the periphery of urban areas.

According to Mncube (2007:27) though, there is a direct correlation between urbanisation and the increase in household energy use, diversification and a move away from using traditional fuels to using fuel at higher levels of the energy ladder. Nansaior, Patanothai, Rambo and Simaraks's (2011) study in Thailand, and Cai and Jiang's (2008) study in China also confirms this. Van der Kroon *et al* (2013:506) refer to the study of Heltberg in Guatemala which indicates that urban energy use resembles an inverted U shape where low income households employ dynamic fuel stacking strategies to meet their energy needs at the bottom, but modern fuels completely displace traditional fuels at the top of the urban energy ladder, thus indicating a full 'transition'. This is not a phenomenon observed in rural areas.

Also, as urban areas expand, various changes occur in people's access to fuels, infrastructure, market diversity, housing choices, and household activities. This influences people's access to and choice of energy and lead to a greater incidence of multiple fuel use. On the other hand, rural areas face fewer changes in their status quo and as a result their markets and energy choices do not change (Van der Kroon *et al,* 2013:508).

Furthermore, Mncube (2007:20) says that the poor do not like to be completely dependent on commercially traded fuels, as higher prices and service unreliability result in energy insecurity. Using multiple fuels therefore fulfil their need for energy security. Consequently, households will adopt new stove types and the fuels that go with it but will rarely abandon the old stove and fuel type (Mncube, 2007:25). Households will typically keep one or two fuels as a backup for when their primary fuels are unavailable (Van der Kroon *et al,* 2013:506). Masera *et al* (2000:2091), in their study of LP gas use in Mexico, mention that the security of using LP gas is not just affected by the route and frequency of fuel delivery, but also the tendency of a stove to malfunction and a family member's ability to repair it. Many factors therefore impact on the security of using different types of energies and the availability of an energy source is an important determinant in the energy choice decision-making process.

In the study done by Sole (2015) in Soshanguve, women prefer to use electricity for their household needs. As one respondent reports: "It's ever ready, you do not need to go elsewhere to fill up or buy…anytime you would want to use it is readily available, unlike wood, you will have to go out and look for them and then start the fire." Note that Soshanguve is surrounded by rural areas with an adequate wood supply. Consequently, residents' first resort is to use wood if they cannot afford electricity. As one resident puts it "We don't buy wood as it's always available…(but) …You have to chop it down first [the tree] and then break it into pieces, and then place it under the sun to dry out' (Sole & Wagner, 2016:5). There is thus some labour involved that acts as a deterrent in selecting it as a fuel choice. As a result, Sole (2015) found that kerosene was also a popular choice. Kerosene is readily available through local 'spaza shops' (tuck shops). Gas, on the other hand is in limited supply and will often require commute to a far-off industrial site that can refill cylinders. One participant said: "I fill up the gas cylinder at the industrial site; however, when the gas is finished I buy paraffin (kerosene) at the garage or the local tuck shops nearby" (Sole & Wagner, 2016:5).

3.4.2 Affordability

The issue of the financial capital of a household has already been mentioned, but the affordability of energy deserves further mention. According to Takama *et al* (2012:1764) affordability is a 'key driver' of the choices people make with regards to fuel and cooking

appliances. Winkler, Simöes, La Rovere, Alam, Rahman and Mwakasonda (2011:1038) state that energy affordability is "the ability of households to afford the connection to electricity access as well as the ability to afford to use this electricity". They are concerned with the share of household income that is spent on energy and posit that at a certain point, the specific 'share' of energy will become unaffordable for a household. The factors that influence this are household income and purchasing power, especially in relation to the opportunity costs of other goods, and the price of electricity when compared to other energy commodities (Winkler *et al,* 2011:1038).

Albertyn *et al* (2012:792) and Tacoma *et al* (2012:1764) say that the very poor generally cannot afford to pay the upfront electricity connection fees in order to benefit from the grid and they do not have the money to buy appliances such as stoves. In addition, Mncube (2007:20) mentions that it often happens that the poor sometimes invest all their savings in acquiring cooking technology like improved biomass stoves when they do not have access to electricity and when they do get access, they often then do not have the capital to afford the connection fee.

Furthermore, paid electricity requires monthly financial commitments, and this is not attractive for people who are barely making ends meet (Albertyn *et al,* 2012:792; Nepal, 2012:2201). The study by Wickramasinghe (2011:7570) for instance, found that the cost of switching to electricity increased a poor rural household's expenditure and constituted up to 25% of their monthly cash income.

Furthermore, Mncube (2007:20-21) cites Victor (2002) who says that poor households have a preferred order in which they satisfy their energy needs. Their most urgent energy need is for cooking and space heating. When this need is satisfied, they seek to satisfy their need for lighting, entertainment and communication. As cooking and space heating is the most intensive energy applications, poor households continue to use cheaper fuels to satisfy these needs first. When these needs are satisfied, people invest in buying electric irons, refrigerators and water heaters. Wickramasinghe (2011:7570) notes that poor households will rather spend their meagre earnings "toward better options in improving living conditions" than pay for 'cleaner' cooking options. That is why poor households will continue to make use of energy sources on the bottom rung of the energy ladder even when more efficient energy sources become available.

3.5 Beyond the ECHDE

Van der Kroon *et al* (2013) omit three important factors from their HDE. These are: the *convenience* and *status* of using certain energy sources and the impact of shocks and trends in the energy sector that can affect a household's *vulnerability* and 'push them down the energy ladder'.

With regards to the issue of convenience, electricity is the most convenient source of energy and can meet all of the household's energy needs. Nevertheless, electricity is expensive. In most urban areas of the developing world, kerosene is available; available in small quantities; suitable for lighting, water heating, and cooking; and allows stove temperatures to be easily regulated. It is usually also relatively affordable (Kebede, Bekele & Kedir, 2002:1034). Charcoal is also convenient, it produces less smoke than wood, is easier to store as it does not degrade and provides heat that can be used for cooking, heating, or non-electric irons (Zulu, 2011:3727).

The WHO (Bruce *et al,* 2002:10), mention that open fires are not just used for cooking, but it also provides lighting and heat. The smoke can be used to repel insects, dry and flavour food, and dry wood and household materials. Using traditional fuels sometimes fulfils multiple functions and it can therefore be desirable for households to continue to use it even if they have access to 'modern' energy (Bruce *et al,* 2002:10).

Of all the household energy sources, wood and kerosene have the lowest status. According to the participants in the focus group discussion, households in Soshanguve would, from a status point of view, rather use wood than kerosene. It seems kerosene use has a stigma attached to it as the fuel used by the 'poorest of the poor'. As one participant put it: "The smell of woodfire on a person is bad enough, but it is much worse to smell of 'paraffin'".

Mncube (2007:28) and Hiemstra-van der Horst and Hovorka (2008:3334) say that energy shortages or higher prices can result in households switching 'downwards' from commercial energy back to traditional fuel. There is evidence that the higher prices for fuels such as kerosene and LP gas has resulted in 'pulling' urban consumers 'down' the energy ladder in many developing counties since 2007 (BMZ, 2014:3). A joint study by the UNEP and IEA in 2007 confirmed that the credit crisis of 2007 pushed the price of local energy up to such an

extent that it has become difficult for the poor to move away from using biomass for their cooking needs (UNEP/IEA, 2007:20). The authors Takama *et al* (2012:1764) relate the example of a study conducted in Ethiopia that shows that the rising price of kerosene forced many urban dwellers to resort to importing wood from rural areas. A study conducted by Maconachie *et al* (2009) in Northern Nigeria confirms that the rising prices of kerosene and other petroleum-based domestic fuels encouraged low income urban dwellers, as well as middle income urban households, to return to using fuel wood for cooking.

In Senegal, households had to revert to using fuel wood when subsidies for LP gas were cancelled. In Madagascar, the price of LP gas went up with more than 55% between 2009 and 2013, forcing consumers to resort back to using charcoal. In Dar es Salaam in Tanzania, the number of households that used LP gas for cooking went down from 43% to 12% whilst the number of households using charcoal went up from 47% to 71% (BMZ, 2014:3).

Poor households are also forced 'down the ladder' when the main breadwinner becomes unemployed. Sole and Wagner quotes a participant who lost her job:

> Poverty pushed me into using multiple fuels. My heart bleeds when I think of using wood – going out to seek wood even when it was raining…you would be sick. In my case, it pains me especially when I have to do it again (Sole & Wagner, 2016:5).

It seems that the lower global fuel prices since 2015 also did not assist in lowering the prices of kerosene and gas. In 2015, the World Energy Council (2015:21) reported that energy and commodity prices were still volatile in Africa, to the point that some governments had to resort to subsidise certain fuel commodities in order to assist the poor. Inadequate supply and higher electricity prices also have an effect of forcing people down the energy ladder (Mncube, 2007:28).

In the case of South Africa, load-shedding forces households to use fuels that they considered obsolete when they received electricity and the assistance of the FBE. Other factors that push individuals and households down the energy ladder is seasonal poverty. The concept of 'seasonal poverty' originates from the studies done by Chambers and his associates concerning the increased vulnerability and poverty that the rural poor experience

during certain seasons (Chambers, Longhurst & Pacey, 1981). Seasonal poverty is not just a rural phenomenon though, the urban poor also experience it as will be seen in Chapter 6.

3.6 South Africa's 'external decision context' and 'external environment'

3.6.1 South Africa's quest for universal energy access

Originally, in 2000, the UN's Millennium Development Goals did not include access to energy as a standalone goal. As mentioned, this changed in 2015 with the adoption of 'universal access to energy' as a stand-alone goal in the new Sustainable Development Goals. Of the seventeen goals listed, Goal 7 embraces a commitment to "ensure access to affordable, reliable, sustainable and modern energy for all" (United Nations, 2015:14).

Before 1994, South Africa had an extremely energy-intensive economy that was dominated by a concern for energy security for its industries, particularly mining, and to provide residential electricity to the white population. Consequently, apartheid policies left a stark contrast between the rich white minority and the poor black majority (Prasad & Visagie, 2005:ii). In 1988, the UNDP's HDI for South Africa indicated that white South Africans ranked above average by comparison to industrialised countries, whilst the poorest 20% of its population ranked 33% lower than the developing country average (Bekker, Eberhard, Gaunt & Marquard, 2008a:3125).

This disparity was also echoed in pre-apartheid infrastructure and service provision (Bekker *et al,* 2008a:3125; Winkler, 2006:26). In 1993, only 36% of all South African households had access to electricity (Winkler, 2006:25). This figure was highly skewed between rural and urban areas. This was as a result of the apartheid government's 'homeland' policy where Africans were encouraged to move to or were forcibly resettled in socially and economically marginalised (mostly) rural areas, which were dubiously seen as historically African areas (Matsika, Erasmus & Twine, 2013:717). The democratically elected ANC government therefore had a momentous task in addressing the skewed energy availability left by the apartheid government. Electricity provision ranked highly on the new government's policy agenda. In the ANC's original Freedom Charter, drafted in the 1950s, the importance of socioeconomic rights to 'house, security and comfort' was stressed (Bekker *et al,* 2008a:3128).

The ANC's struggle to secure access for the population to basic services in the 1980s helped shape the country's constitution and Bill of Rights which stresses its citizens' rights to a clean environment and access to basic services (Calland & Nakhooda, 2012:914). The South African government had 'access to energy' as an important goal in its social policies mix since 1994. This was concretised in the government's Reconstruction and Development Program (RDP) which aimed to provide basic services such as water, electricity, housing, education, and health to all South Africans, and especially to those who had previously been excluded from it (Bekker *et al,* 2008a:3128). The new government took the slogan of "Electricity-for-AII" on board for its future focus on universal energy access (Ballantyne, 2012) and the constitutional court of South Africa pronounced access to electricity as an 'implied right' (Ijeoma & Okafor, 2014:36, citing Adam 2010).

The new government inherited a relatively reliable and established electricity state utility, Eskom, to implement its new energy policies and laws (Okafor, Okechukwu & Iloanya, 2015:151) as well as the National Electrification Forum (NELF) which was established in 1992 and which was tasked to enact new energy policies. The NELF launched the first phase of the National Electrification Programme (NEP) in 1994 with the aim of expanding the electric grid to reach the RDP target of 2.5 million houses by the year 2000 (Louw, Conradie, Howells & Dekenah, 2008: 2813). It must be mentioned that this goal was focused on electrification for poor urban areas. Nevertheless, electrification continued at a rapid pace in the first phase of the NEP. Statistics from the national census of 2001 revealed that of the households surveyed, 67% of them used electricity for lighting (Statistics South Africa, 2005:114). This meant that by 2001 two thirds of the country's households had access to electricity (Statistics South Africa, 2005:145).

The first phase of the NEP contributed significantly to the reduction of poverty and bettering the lives of previously disadvantaged communities (Tinto & Banda, 2005). Thousands of disadvantaged areas, schools and clinics were now connected to the grid (Prasad & Visagie, 2006:1). The success of South Africa's NEP even led some authors such as Tinto and Banda (2005:26-30, 32) to state that South Africa's NEP was a symbol of the country's newfound democracy.

Phase two of the NEP started in 2000. Electrification slowed down considerably during this period. There are many reasons for this, but this was mainly due to the government

restructuring government and the energy industry in 2001 according to their vision for an 'Integrated government'. This restructuring involved the corporatisation of Eskom, and the creation of a number of independent regional distributors, transmission companies and system operators. As a result, much confusion reigned at the local level over who was responsible for energy service delivery (Bekker *et al,* 2008a:3129-3130). Furthermore, the predominant focus in this second phase of the NEP was to address the backlog of electricity access in rural areas. This was challenging, as rural electrification had to start from a baseline of a lack of established bulk infrastructure.

In 2004, the NEP, now under the management of The National Energy Regulator of South Africa (NERSA), collapsed, and the Department of Mineral and Energy (DME) stepped in to manage the programme (Sole, 2015:12). In 2005 the NEP was renamed the Integrated National Electrification Programme (INEP) and the DME was renamed the Department of Energy (DoE) (Tait & Winkler, 2012:4).

The DoE adopted a more realistic target of 92% electrification of all formal households by 2015 (Ijeoma & Okafor, 2014:37). This meant that South Africa was not able to meet the UN MDG target of universal energy access for 2015 (Ijeoma & Okafor, 2014:33). Nevertheless, at this stage, it was clearly understood that Eskom was responsible for electrification in rural areas (National Electrification Advisory Committee (NEAC), 2007:2). The census results of 2012 revealed that, out of South Africa's 15 million households, 84,7% of them used electricity for lighting (Statistics South Africa, 2012:58, 61). In the 2014/2015 annual performance plan of the DoE (2014:8), the department claimed that the rate of electrification had reached 86% (DoE, 2014:8), but again estimated that it was 85% in 2017 (DoE, 2017:12). In 2013 the government shifted its goal for universal access to 2025.

Since 2007, South Africa's energy supply structure became highly unstable, weak and vulnerable. There was a large excess capacity of electricity during the 1980s and 1990s. As a result, the construction of new plants was put on hold or cancelled. At the same time, Eskom experienced funding issues, maintenance backlogs and service delays (Winkler & Marquard, 2009:52; Bekker *et al,* 2014:792). This happened while the country experienced increasingly high economic growth rates – up to 5% by 2007 (Van Es & Bennett, 2007:1). Together with the greater demand for electricity due to grid extension and the FBE policy

(see section 3.4.2) (Thopil & Pouris, 2015:507), electricity demand began to outstrip supply (Musango, 2014:306).

As a result, Eskom resorted to power cuts or 'load shedding' at certain times and in certain places as well as buying back energy from high-energy grid users, to reduce pressure on the grid (Bekker *et al,* 2014:791). To assist with this, an Integrated Demand Management (IDM) division was established and the National Energy Efficiency Strategy of South Africa was reviewed (Van Blommestien & Daim, 2013:13). A new Electricity Pricing Policy was also enacted (Okafor *et al,* 2015:155).

Eskom's problems were not just harmful to the South African economy, but it also had negative effects on the living standards of the poor. Herman, Gaunt and Tait (2015:463) for instance mention that power outages in poor areas interrupted economic activities, caused food spoilage, increased feelings of vulnerability, and contributed to crime on dark nights. More importantly, it also forced the poor to make use of previously obsolete fuel sources such as kerosene for lighting, and wood and biomass for cooking.

Furthermore, the pressure on the government to invest in new electricity generation and transmission infrastructure led to higher electricity prices (Thopil & Pouris, 2015:508). The DoE (2013:7) mention that many poor consumers held service delivery protests or resorted to illegal connections as a survivalist tactic because of higher electricity prices since 2007. Sole (2015:15) cites a Department of Mineral Resources (DMR) report (2012) that mentions that the electricity price increase forced 41% of South Africans to reduce their electricity usage and 26% of households to resort to using other energy sources to cope. Even though the DoE introduced an 'Inclined Block Tariff' (IBT) in 2010 to reward households that do not use large amounts of electricity with lower electricity tariffs (DoE, 2013:iii, 6) the poor still felt the strain of higher electricity prices. In fact, in 2015 NERSA approved a 9.4% electricity increase for 2016/17. This is above the national inflation rate of 6% (Sole & Wagner, 2016:1).

3.6.2 South Africa's electricity basic service support tariff or FBE

Central to the idea of the 'energy ladder' theory is the policy recommendation that, should households be unable to move up the ladder due to financial constraints, they should be assisted to do so. To accomplish this, the supporters of the HEL theory recommend that households not just be given access to modern fuels, but that these fuels should be subsidised. In this instance then, subsidies are an alternative to 'higher income' (Masera *et al,* 2000:2088).

DeFries and Pandey's (2010:130) study of urban fuel use in India, demonstrates the positive contribution that state subsidies can make to enable poor households to use 'cleaner' energy sources. The Indian government's LP gas subsidy program for instance, resulted in a 70% reduction in the use of fuel wood in urban areas.

By the mid 2000's it became apparent to the South Africa government that many households did not benefit from electricity access due to its unaffordability (Mapako & Prasad, 2005:1). A study done by Howells *et al* in 2006 in urban Kayelitsha in the Western Cape for instance revealed that electricity was used for television, lighting, irons, and a few other applications for which fuel substitutes where inferior or absent. However, the households only consumed about 20kWh of electricity per month. Electricity for cooking, water and space heating was unaffordable and as a result, households continued to rely on traditional fuels such as coal or firewood for cooking and heating.

In 2003, the Department of Minerals and Energy committed itself to a free basic electricity (FBE) allowance for poor households in order to assist them to be able to use more electricity to meet their household energy needs. It is also known as the electricity basic service support tariff or EBSST (Prasad & Visagie, 2006:1). All households in South Africa were given 5 to 6kWh of free electricity per month, enough to cover their basic need for lighting (DoE, 2013:6). Households that qualified as 'indigent' could apply for an additional 50kWh of free electricity monthly from their municipalities (Prasad & Visagie, 2006:1). This provision of 50kWh was also separated from the household's total electricity consumption so that they did not get penalized for using more electricity according to the stepped tariff billing system (Makonese *et al,* 2012). The FBE is available for purchase on the 1st of every month and is valid for only a month. The FBE cannot accumulate or be claimed over a period.

The decision to allocate the specific amount of 50kWh was as a result of research done by the University of Cape Town's Energy Research Centre and Eskom, who found that 56% of households that have access to electricity in South Africa use this amount of electricity per month and that this amount would be enough to meet households' need for lighting, some water heating, media access, some ironing, and cooking (Makonese *et al,* 2012).

The DoE also introduced a Free Basic Alternative Energy (FBAE) policy to assist rural 'indigent' households that do not have access to electricity to have access to R50 worth of alternative energy. This policy aimed to assist poor households to have access to some form of energy for lighting and cooking. It is up to municipalities to decide what energy types they will subsidise (DPLG 2006b:5). Mbombela municipality for instance, provide free biogels for use in a gel stove to provide energy for cooking and lighting (Mbombela Local Municipality, n.d.:9). According to the DoE's 2013 publication, other subsidised fuels are LP gas, kerosene, and coal (DoE, 2013:7). The latter two fuels are perturbing, as they are not in line with the government's commitment to ensure that all South Africans have access to energy 'that does not endanger their health'.

According to the DoE (2013:71), 69% of all households identified as 'indigent' in the 2001 census received the FBE by 2013. A review of the literature does not reveal how many new 'indigent' households have emerged, nor how many of them are receiving the FBE.

The study done by Howells *et al* (2005), reveal that the 50kWh FBE had a positive impact on the livelihoods and living standards of the households that received it. The reduced expenditure on energy meant that they had more disposable income and they were not completely reliant on 'dirty' fuels (Howells *et al,* 2005:7). Studies done in rural areas by Mapako and Prasad (2005) also revealed notable benefits for the households that received the FBE. Benefits included longer use of better quality lighting, perception of improved safety and security, access to media using television and radio, and reduction in fuelwood use.

A study of poor communities in Cape Town, also showed that they use 30 to 35kWh more electricity after they received the FBE (Winkler *et al,* 2011:1045). The study by Howells *et al* (2005:7) also confirms this, showing that some households could now afford to buy and use electric cookers and use electricity for water heating. This brought their electricity usage to about 50kWh per household per month. Table 3.1 depicts the general share of household

expenditure on energy before and after the introduction of the EBSST. The data is based on a study done by Prasad and Ranniger in 2003.

Table 3.1: Impact of EBBST on poor household energy burden in 2003, South Africa

Expenditure on	Before subsidy	After subsidy	Difference	
Electricity (R/month)	38	31	7	18%
Fuels excluding electricity (R/month)	70	59	11	16%
Energy as% of household expenditure	18%	12%	6%	

Source: Winkler et al (2011:1045). Based on a study done by Prasad and Ranniger (2003).

Nevertheless, the FBE policy has come under criticism. The first criticism levelled against it is the way in which the 'indigency' status is decided on by municipalities. As was mentioned in Chapter 1, every municipality can determine their own criteria. The basic description of 'indigency' only has a few guidelines such as that their property value may not exceed R150,000 (the typical value of a RDP house), the total income of the household must not be more than the added total of two state pensions and that child-headed households and the elderly must be given priority (Makonese *et al,* 2012; DPLG, 2006b). In practice though, the interpretation and registration of 'indigency' status is uneven and results in lower-risk households being registered whilst more vulnerable households don't qualify. This can also be seen as a result of the fact that the qualification for 'indigency' status does not take into account the size of a household relative to its total income (Makonese *et al,* 2012).

Furthermore, in order to register to receive the FBE, households have to agree to the installation of a prepaid electricity meter in their homes. These prepaid systems were rolled out by Eskom in 2003 to avoid the non-payment of electricity services. By 2012, 3.2 million households used these systems (Makonese *et al,* 2012). Prepaid systems operate as follows: consumers buy tokens – each with a unique number (such as pre-paid mobile phone air time) – and load an amount of electricity onto their meters. When their units are depleted, they must buy more tokens (Makonese *et al,* 2012). Prepaid meters have several benefits. For example, it aids the household in keeping track of its energy expenditure and their household budget. It also helps them to prioritise certain appliances and/or uses when the

energy units run low (focus group discussion) (Makonese *et al,* 2012). Also, consumers do not have to go through the inconvenience of having their meters read, account posting costs, they do not have to fear disconnection and reconnection fees, and other administrative issues. Furthermore, this system improves municipal cash flow (Makonese *et al,* 2012).

Nevertheless, the amount of power accessible to these households are fixed at 10 Amp, which means that frequent electrical failures or surges occur, causing damage to appliances and annoyances, especially on dark or cold nights (Makonese *et al,* 2012). Furthermore, the meters are a cause for inequality amongst electricity consumers as those who buy directly from Eskom get more value for their money. A token of R50, for instance, will only buy you 44 units whilst households who buy from Eskom will get twice that amount (Makonese *et al,* 2012).

There is also some concern that the installation of these meters is 'forced' on consumers in order to quality for debt negotiations and the reception of free services like the FBE. As a result, many consumers have resorted to tampering with the prepaid meters in order to obtain electricity illegally. There are many ways in which these meters can be 'fixed'. This action resulted in the municipality taking stronger measures to protect prepaid meters and to introduce 'split meters' which are tamper proof (Makonese *et al,* 2012). Other complaints are that the systems 'continue to charge even when there was no money' and that 'it takes a long time for electricity to become available after tokens have been loaded' and that 'tariffs suddenly increase with the installation of prepaid meters' (Makonese *et al,* 2012).

Other criticisms levelled at the FBE comes from Wentzel (2004) who is concerned about the fact that some municipalities supply more than 50kWh electricity free to its residents. He says that this causes rich urban municipalities and metros to supply high levels of FBE to all its consumers, regardless of whether they qualify or not and that in contrast, rural, resource-strapped municipalities can only afford to supply part of the recommended 50kWh to its eligible consumers. According to them, this leads to regional and urban/rural inequalities.

Furthermore, organisations like Cosatu criticise the fact that 50kWh is insufficient to cover basic cooking and refrigeration. Table 3.2 shows the typical energy consumption of some basic household appliances. As can be seen, even a small basic refrigerator will use a total

of 50kWh a month if it is run continuously. It is clear that a household of any size will struggle to meet their basic energy needs with this amount of electricity.

Table 3.2: Typical energy consumption and estimated hours of use of domestic appliances

Item	Power rating (w)	Daily use (h)	Days used	Monthly energy consumption (kWh)
1x Energy saver light	11	5.0	30	1.7
1x TV (B&W)	35	6.0	30	7
1x Iron	1 000	4.0	6	24
1x Kettle	1 000	0.5	30	15
1x Hot plate	1 000	1.0	25	25
1 x Regular light	100	5.0	30	15
1x Refrigerator (20 L)	250	6.5	30	49

Source: Makonese et al (2012)

Makonese *et al* (2012) mention that, from the above table, it is apparent that even the generous 100kWh issued by municipalities like Tshwane and Johannesburg will not be sufficient to meet people's energy needs. It would be reasonable to assume that these households will continue to make use of other fuels, especially for cooking and heating, as these are the most energy intensive applications. As a result, organisations like Earthlife Africa Johannesburg states that 200kWh of free electricity would be more acceptable to meet the energy needs of the poor (Makonese *et al,* 2012).

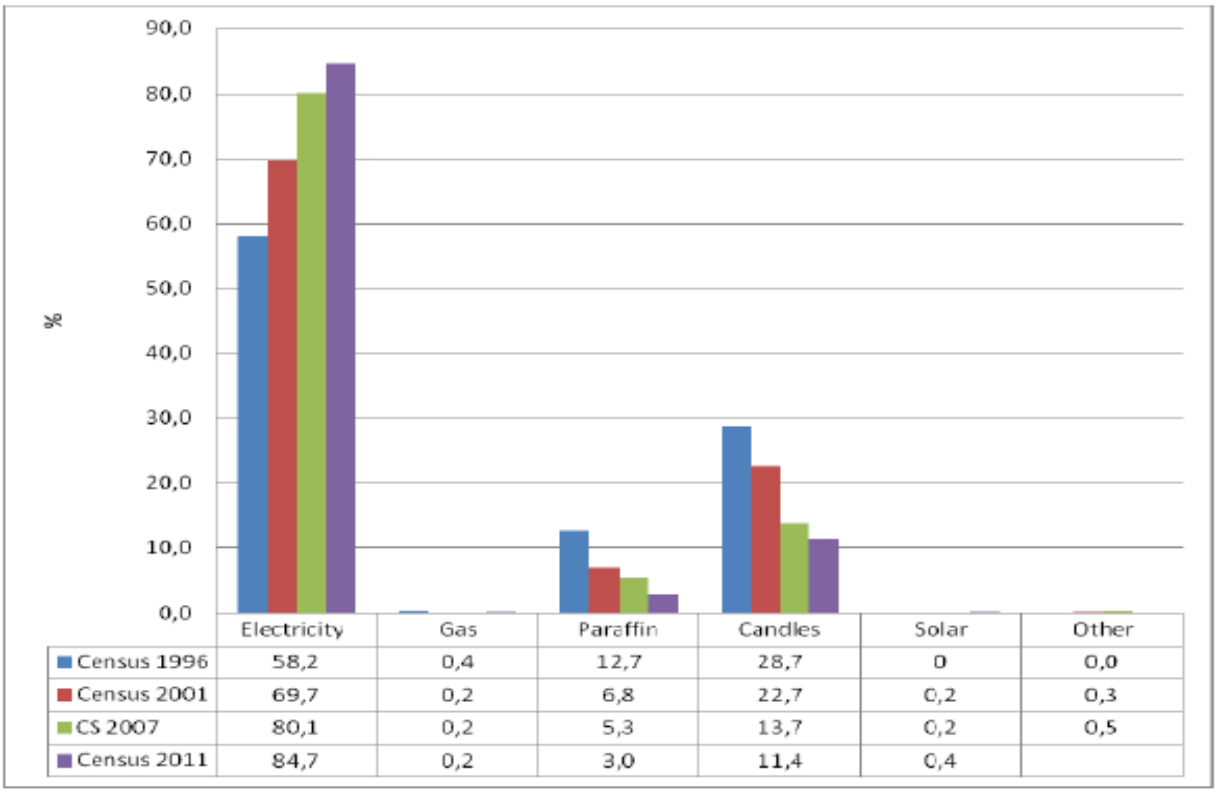
Nevertheless, the increased use of coal-fired grid electricity which goes hand in hand with the increased use of electricity through the FBE does not go unnoticed. The author Basson (n.d.:7), for instance, argue that the policy of providing FBE to poor communities continues to support a capital- and energy-intensive form of economic development and is therefore unsustainable. Howells *et al* (2005) share this opinion and claim that the FBE distort the energy choices of poor households by encouraging them to cook with electricity, whereas alternatives such as LP gas can deliver a similar cooking service at a much lower cost. They

are therefore in favour of providing LP gas through the FBAE to *all* 'indigent' households, rather than the FBE.

3.6.3 Multiple fuel use by the poor in South Africa

As a result of apartheid policies, most South Africans were reliant on kerosene, gas and wood in 1994 as their main source of energy (DoE, 2012:5). Following electrification, this number came down considerably by 2001. Figure 3.2 illustrates the change of different types of energy used for domestic lighting since 1996. Note that the word 'paraffin' refers to kerosene.

Figure 3.2: Percentage distribution of households by type of energy used for lighting



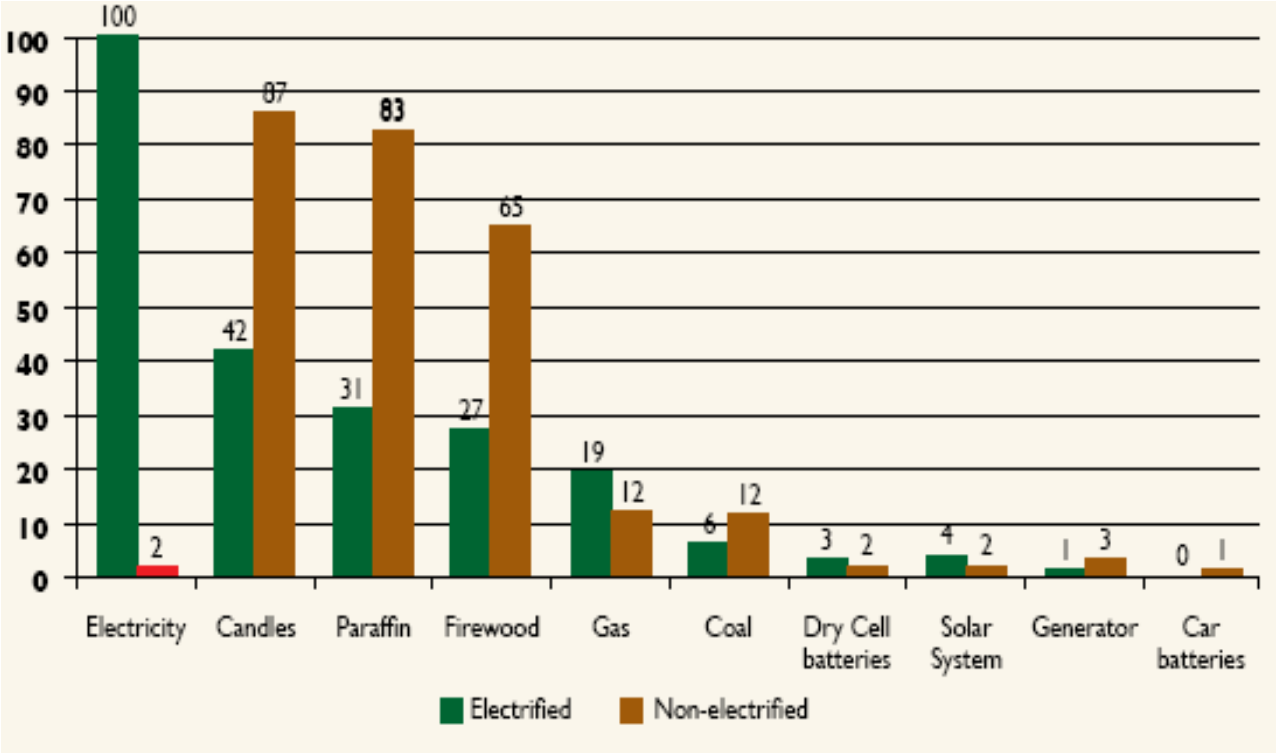
	Electricity	Gas	Paraffin	Candles	Solar	Other
Census 1996	58,2	0,4	12,7	28,7	0	0,0
Census 2001	69,7	0,2	6,8	22,7	0,2	0,3
CS 2007	80,1	0,2	5,3	13,7	0,2	0,5
Census 2011	84,7	0,2	3,0	11,4	0,4	

Source: Stats SA (2012:61)

Nevertheless, the DoE (2012:18) makes it clear that their 2012 survey confirms that even though the use of 'dirty' fuels have been reduced for household energy purposes, many poor South African households continue to make use of multiple fuels when they receive electricity and they do *not* automatically move up a unidirectional 'energy ladder' once they

are connected to the grid. Figure 3.3 reveals the household energy sources used for lighting, cooking and heating in the 2012 DoE national survey.

Figure 3.3: Use of energy sources among South African households, by electrification status (percent using)

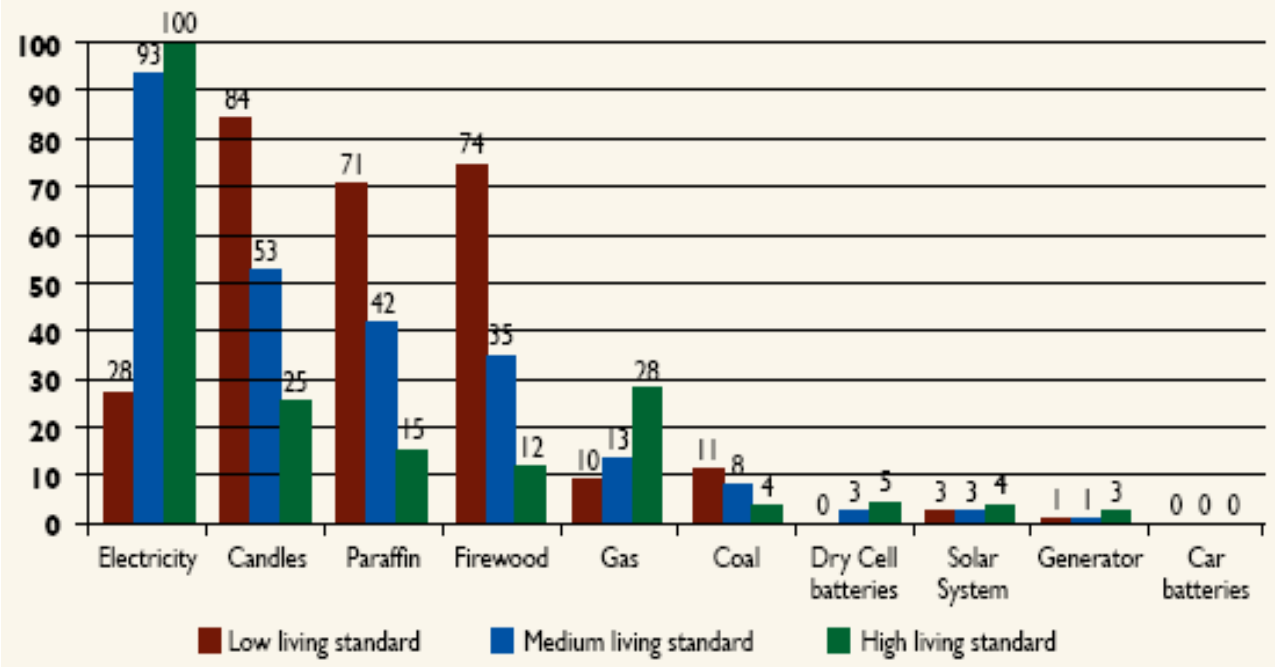


Source: DoE (2013:20)

The study reveals that candles, firewood and kerosene are used by more than 70% of households in the low LSM category, indicating a strong correlation between the use of these fuels and poverty (DoE, 2013:20). Figure 3.4 on page 76 shows the incidence of fuel use amongst the three living standard household groups in South Africa.

As can be seen, the lowest LSM households of South Africa use about 65% less electricity than middle LSM's and 72% less than high LSM households. In turn, they use about a third more candles and kerosene than middle LSM households and more than 50% compared to high LSM groups and a staggering 40% more firewood than ordinary middle LSM households and 62% more than high LSM households. This is a lot of firewood if one considers the popularity of the recreational wood-fire barbecue amongst *all* income groups in South Africa. In contrast, low-income households and middle-income households are less inclined to use gas than households in high income categories.

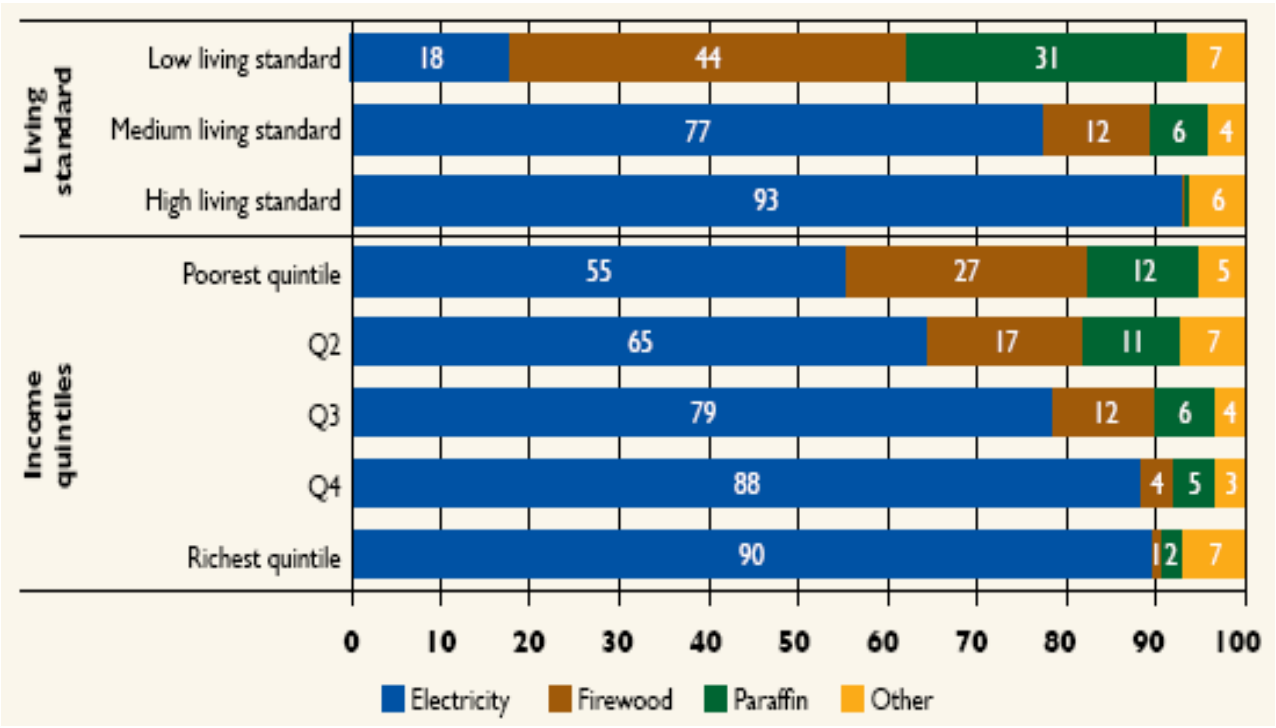
Figure 3.4: Use of Energy Sources by living standard level (percent using)



Source: DoE (2013:21)

Figure 3.5 shows the main energy source for *cooking* amongst the different income groups.

Figure 3.5: Main energy source for cooking, by LSM and quintiles of per capita monthly income (percent using)



Source: DoE (2013:25)

It is clear from the above table that households with a low living standard and those in the poorest quintile have a greater reliance on multiple energy sources. The DoE study also shows that kerosene is the fuel source used most in combination with other energy sources. It is used 7% of the time in conjunction with electricity, 10% in conjunction with candles *and* electricity and 2% in conjunction with other combinations such as gas (DoE, 2013:30).

Table 3.3 shows the profile of multiple energy choices for cooking according to electrification status and living standards. The most popular combination of energy sources amongst the poor for cooking is a combination of firewood and kerosene.

Table 3.3: Energy choices for cooking, by electrification status and living standard (column percent)

Multiple energy sources for cooking	South Africa	Electrified	Non-electrified	Low	Medium	High
Single energy use	***52***	***52***	***50***	***41***	***47***	***65***
Electricity only	42	47	1	5	37	62
Firewood only	4	3	16	18	4	0
Paraffin only	4	0	31	16	4	0
Gas only	1	0	1	0	0	1
Solar system only	1	1	1	1	1	0
Coal only	0	0	0	1	0	0
Other source only	0	0	0	0	0	0
Multiple energy use	***48***	***48***	***50***	***59***	***53***	***35***
Firewood & electricity	11	12	0	7	16	4
Gas & electricity	8	9	0	0	5	16
Paraffin & electricity	11	13	0	4	16	6
Paraffin, firewood & electricity	4	4	0	4	5	1
Paraffin & firewood	4	0	33	30	1	0
Paraffin, gas & electricity	2	2	0	0	2	1
Gas, firewood & electricity	1	1	0	0	1	1
Coal & electricity	1	1	0	0	2	1
Paraffin & gas	0	0	3	2	0	0
Paraffin, gas & firewood	1	0	3	1	1	0
Other energy combinations	5	5	11	11	5	4
Total	**100**	**100**	**100**	**100**	**100**	**100**

Source: DoE (2013:34)

As can be seen, 59% of low LSM households use multiple fuels compared to 53% of middle LSM households and 35% of high LSM households. Low LSM households' energy preference for cooking is as follow: a combination of kerosene and firewood (30%), firewood only (18%), kerosene only (16%), a combination of different energies (possibly including coal) (11%), a combination of electricity and firewood (7%), electricity only (5%) and then in equal measures kerosene and electricity and kerosene, firewood and electricity (4%). Three households use a kerosene and gas combination and another three a kerosene, gas and firewood combination.

When it comes to space heating and keeping warm, a greater proportion of households are reliant on a single energy source than with cooking. Table 3.4 shows the incidence of multiple fuel use for space heating purposes.

Table 3.4: Energy choices for heating rooms and keeping warm, by electrification status and living standard (column percent)

Multiple energy sources for heating	South Africa	Electrified	Non-electrified	Low	Medium	High
Single energy use	***55***	***55***	***57***	***58***	***50***	***62***
Electricity only	34	38	1	3	27	54
Firewood only	12	9	38	43	13	2
Paraffin only	6	4	16	9	7	2
Gas only	1	2	0	0	1	2
Coal only	1	1	2	3	2	0
Dry cell batteries only	1	1	1	0	0	1
Solar system only	0	0	0	0	0	0
Generator only	0	0	0	0	0	0
Multiple energy use	***27***	***27***	***21***	***24***	***28***	***23***
Paraffin & electricity	7	8	0	2	9	4
Firewood & electricity	4	5	0	1	5	4
Gas & electricity	3	3	0	0	1	7
Paraffin & firewood	3	1	13	12	2	0
Paraffin, firewood & electricity	2	2	0	2	3	0
Paraffin, gas & electricity	1	1	0	0	1	1
Coal & electricity	1	1	0	0	2	1
Other energy combinations	5	5	8	7	5	5
No energy source used for space heating and keeping warm	***18***	***18***	***22***	***18***	***22***	***15***
Blankets, warm clothing & hot water bottles	17	17	20	17	20	15
None of the above	1	1	1	0	2	1
Total	**100**	**100**	**100**	**100**	**100**	**100**

Source: DoE (2013:37)

As can be seen, low LSM households prefer to use one specific energy sources for space heating. The energy source most popularly used for this is firewood, with 43% of low LSM households using this as their single source of energy. The second most popular use for space heating is a combination of kerosene and firewood (11%) and the third is kerosene only (9%) (DoE, 2013:37). Only three households made use of electricity only and another three only uses coal.

3.7 Conclusion

This chapter looked at Van den Kroon's Energy Choice Household Decision Environment or ECHDE. Three crucial factors in the 'household opportunity set' of the ECHDE was discussed, namely, household financial, human and social capital. In an area such as Soshanguve, it can be expected that the 'external decision context' and 'external environment' of households will be very similar, but that every household has a unique set of 'household capitals' or assets which will determine the choices they make towards the energy strategies they choose as a livelihood strategy.

The determining factors that influence household's choice of fuels was discussed. The acceptability of an energy source was discussed as a factor that originates from the household's culture and is part of its social capital and 'household opportunity set'. The issues of affordability of fuels are related to the household's financial capital, but, as with the 'availability' of certain fuels, falls within the 'external decision context' of a household as it relates to factors that are beyond the household's control and relate to the issue of markets and infrastructure.

The factors of 'convenience', 'status' of fuels and the energy vulnerability of households was also discussed as issues that will have an impact on a household's ECHDE.

Lastly, the chapter focused on the 'external decision context' environment of South Africa's communities by looking at the government's quest for universal energy access and the efforts it has made to make electricity affordable to poor households. The FBE was critically discussed as well as the factors that are responsible for making South African households 'vulnerable'. A picture was also sketched of the incidence of multiple fuel use of poor households in South Africa.

To conclude, Hiemstra-van der Horst and Hovorka (2008:3342) state:

> "...energy-use patterns ... are not mainly driven by the desperation of poverty or a simple struggle to overcome developmental constraints. Rather they are the product of active decision making on the part of individual households according to their preferences and broader lifestyle considerations, which, moreover, are diverse rather than uniform."

CHAPTER 4
STUDY AREA: SOSHANGUVE

4.1 Introduction

To introduce a discussion of Soshanguve, it is important to place it within its wider geographical context. As Soshanguve is a township in a specific administrative region of the City of Tshwane, which is again part of the province of Gauteng, this chapter attempts to place the discussion of geographic location, demography, electricity access, the FBE, and multiple fuel use in its wider perspective. This will be done by first discussing the provincial context, the context within the City of Tshwane municipality, then, where possible, the sub regional context, and then that of Soshanguve itself.

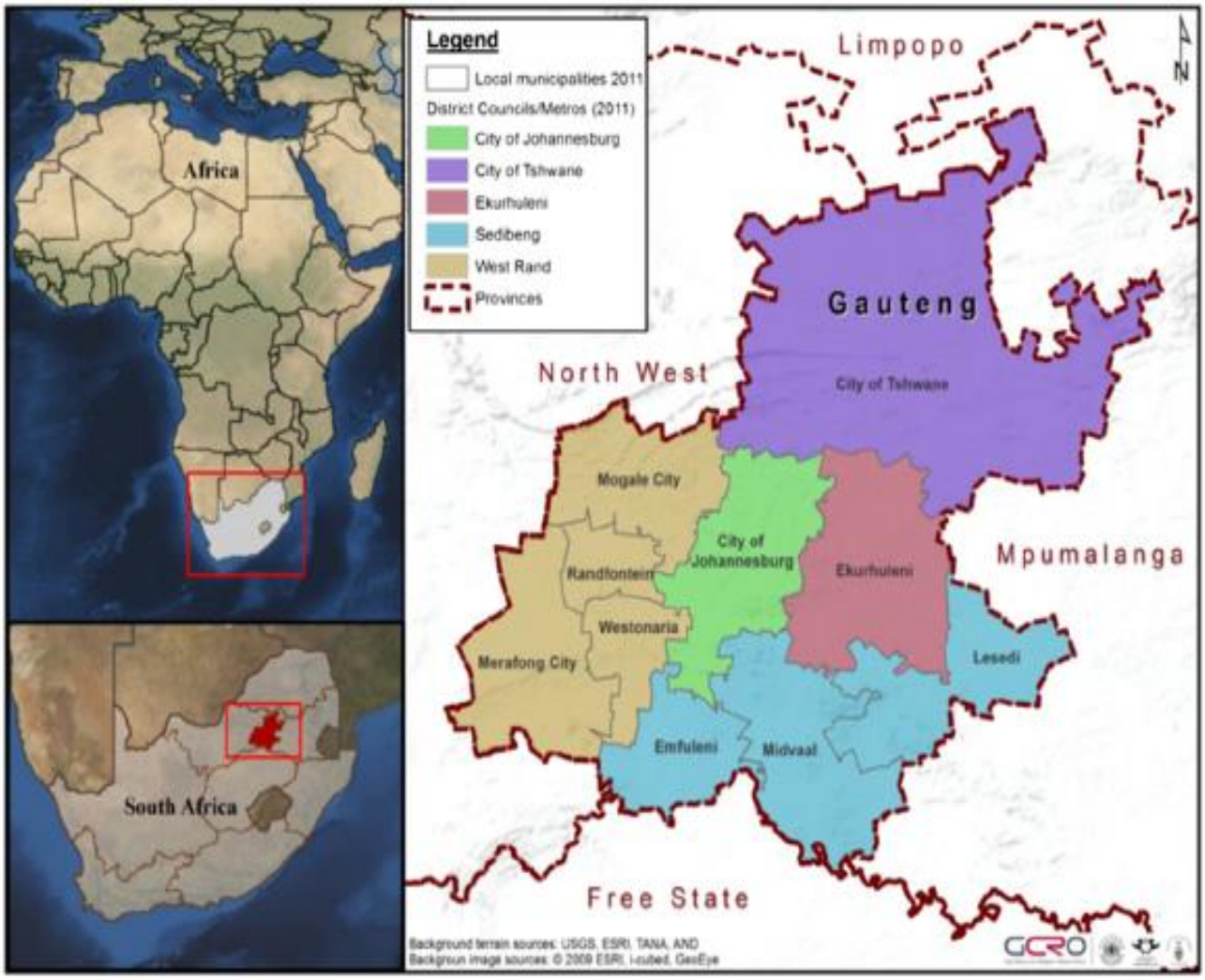
The first part of the discussion will examine population demographics, household income and the HDI of households, average household size, educational levels, infrastructure, and transport. The second part of the discussion will focus on electricity access in Gauteng and the city of Tshwane, and the roll-out of the FBE and SWH in Tshwane municipality.

Lastly, some case studies of urban multiple fuel in central areas of Gauteng will be reviewed as well as a case study of multiple fuel use in Soshanguve.

4.2 Geographic location and demography

Soshanguve is an urban, semi-formal area in the north-western part of Gauteng province, situated 25 km north of the administrative capital, Pretoria, and falls within the jurisdiction of the City of Tshwane Metropolitan Municipality (The City of Tshwane Metropolitan Municipality). Figure 4.1 shows the location of the City of Tshwane relative to Gauteng province, South Africa. For those who are viewing the map in black and white, the city of Tshwane municipality is the darkest and biggest municipality to the north of the province.

Figure 4.1: Geographical location of the City of Tshwane Metropolitan municipality in Gauteng province, in South Africa, in Africa



Source: Musango (2014:307) (Taken from Nyar & Musango, 2013)

Gauteng province is the smallest of the nine provinces in South Africa, but is the most densely populated, comprising 13.2 million people and 24% of SA's population (Gauteng Provincial Treasury, 2016:xiv,10). Gauteng is also the wealthiest province in South African and contributes 35% of the national GDP (Gauteng Provincial Treasury, 2016:12). Despite its wealth, the province is plagued by – among others – unemployment, poverty, inequality, rapid urbanisation and migration (Musango, 2014:306; Gauteng Provincial Treasury, 2016:xiv). For instance, since 2010, Gauteng's population increased by almost 1.2 million people, of which 543,000 were migrants from underdeveloped rural areas in adjacent provinces (Gauteng Provincial Treasury, 2016:10, 13). These high levels of urbanisation are proportional to the growth of informal settlements where rural poverty is transformed into

urban poverty (Gauteng Provincial Treasury, 2016:14-15). About 20% of Gauteng's residents live in informal settlements (Gauteng Provincial Treasury, 2016:xvi).

Gauteng has an unemployment rate of 27.6%, which has risen by 4% since 2000 (Gauteng Provincial Treasury, 2016:xv; Gauteng Province Department of Roads and Transport, 2016:42). Many of the unemployed are youth between the ages of 15 to 24 years (44%) (Gauteng Provincial Treasury, 2016:37). Only a third of those who are employed work the usual five days a week (Gauteng Province Department of Roads and Transport, 2016:42) and about 16% of people who live in Gauteng work in the informal sector (Gauteng Provincial Treasury, 2016:41).

The average level of education in Gauteng is 'some high school' (37%) and 'matric' (34%) with about 9% of residents having a diploma, 6% a degree and 6% 'some primary school' (Gauteng Provincial Treasury, 2016:60). The number of people who live on social grants has increased by 200,000 from 2014 to 2016 (Gauteng Provincial Treasury, 2016:63). The province has 13 municipalities of which three are metropoles (Musango, 2014:307).

Tshwane municipality is Gauteng's largest metropolitan municipality – in terms of landmass. In 2011, the Metsweding District Municipality (which included Cullinan and Bronkhorstpruit) was incorporated into the City of Tshwane to become the Tshwane Metropolitan Council. This meant that rural areas and areas that were formerly tribal homeland territory were incorporated into an urban metropolis (Parliament of the Republic of South Africa Research Unit, 2013:9; Maepa, 2014:177). This merger made Tshwane muncipality the third largest metropolitan municipality in the world according to landmass, after New York and Tokyo (Parliament of the Republic of South Africa Research Unit, 2013:9; Maepa, 2014:177).

The HDI for Tshwane municipality is 13.6% higher than the national average (Tshwane Economic Development Agency, n.d.). It also has the smallest share of people living below the poverty income line of R577 a month (Gauteng Provincial Treasury, 2016:63). The majority population group is Black/African (75.57%), with 20.5% whites, 2% coloured and 1.8% Asian (Gauteng Province Department of Roads and Transport, 2016:15). The average household size is 3.4 individuals and 29% of Tshwane residents are aged 15 to 30, so, like the rest of Gauteng, it has a youthful population (Curry *et al,* 2017:77). Consequently 71.9%

of City of Tshwane municpality residents are of working age (Mbalo Brief Statistics South Africa, 2014:2-3).

The incorporation of the former Metsweding District Municipality increased the number of informal settlements in the municipality to 124 in 2015. These informal settlement areas are spread across the region (Ramokgopa, 2015:14). Although Tshwane muncipality has a higher HDI than the national average, the municipality has high levels of inequality (Gauteng Provincial Treasury, 2016:63) with rising levels of unemployment, which gives rise to homelesness, theft and vandalism (Parliament of the Republic of South Africa Research Unit, 2013:22).

For administrative purposes, the municipality has been divided into seven regions. Soshanguve falls into two of these regions, with the biggest part of Soshanguve falling into Region 1 (Mamogale, 2011:3). Figure 4.2 shows the seven regions of Tshwane Municipality and highlights Region 1. Note that the Tswhane city centre is marked by a star to illustrate Region 1's location relative to the city centre.

Figure 4.2: Geographical location of Region 1 in Tshwane Metropolitan Municipality

Source: Tshwane Economic Development Agency (n.d.n.p)

Soshangvue was established in 1974 during the apartheid era (Nkwonta & Ochieng, 2009:246) as a residential area for migrant workers (GWA Studio, 2007:5). It spans roughly

126km^2 and, in 2014, it had 136 482 households (Gauteng Province Department of Roads and Transport, 2016:8). Figure 4.3 shows the geographical location of Soshanguve relative to its neigbours.

Figure 4.3:The geographical location of Soshanguve and surrounding suburbs

Source: Google Maps, Soshanguve

Soshanguve's northernmost part falls within Region 2 and borders North West province in the north and rural areas to its west and east. The part of Soshanguve that falls within Region

1 is bordered by Mabopane to the west and Ga-Rankuwa and North West to its southwest. Soshanguve is bordered by the R80 road and the Onderstepoort Private Nature Reserve to its southeast.

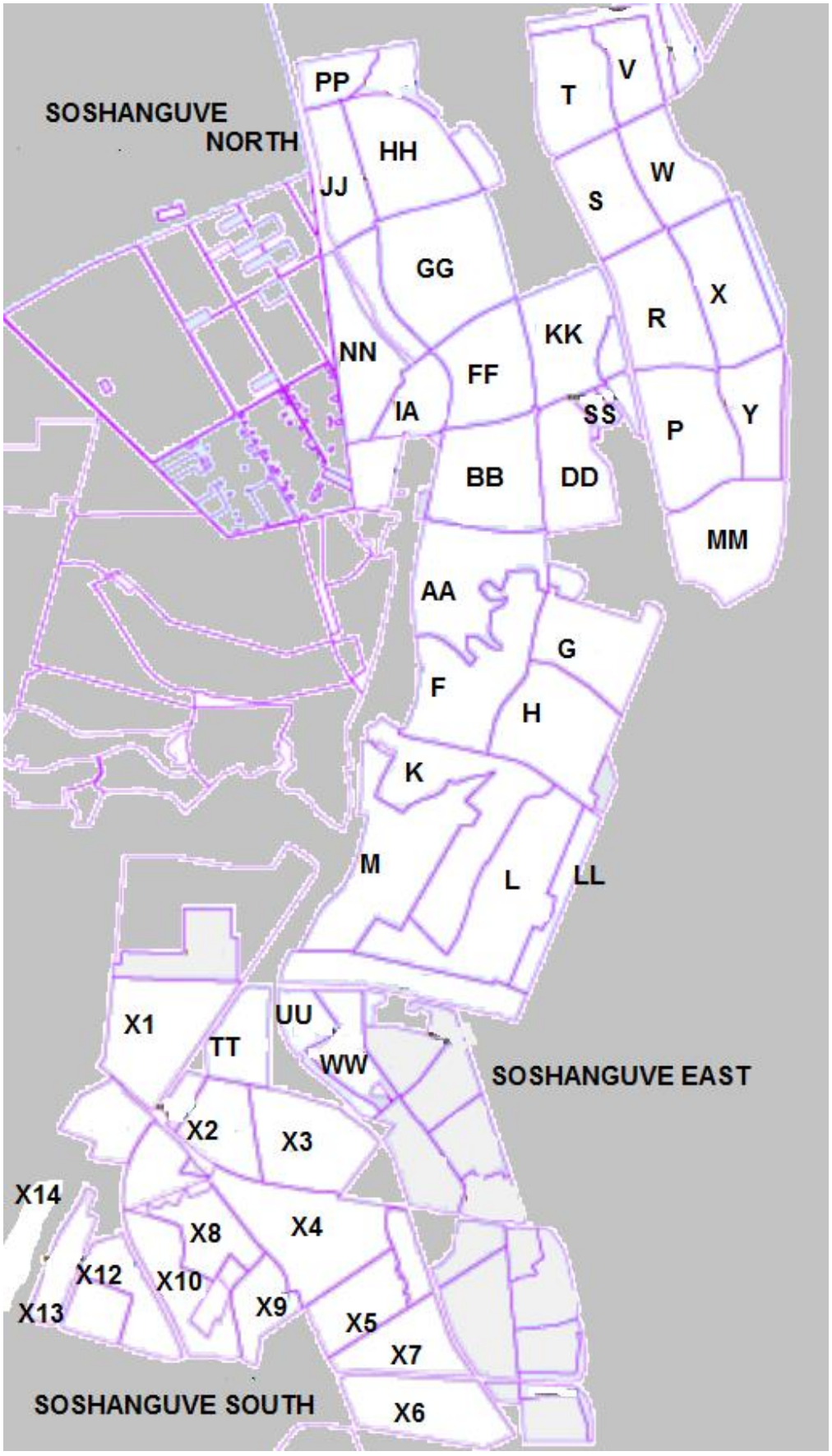
As Soshangvue is proximal to the borders of North West province, it a recipient area for the influx of unskilled migrants from the surrounding provinces of North West and Limpopo, and, consequently, it is part of what the government calls a 'transitional zone' in the urbanisation process (Parliament of the Republic of South Africa Research Unit, 2013:12). It is also the recipient area for migrants from other African countries (focus group discussion).

Soshanguve is divided into 63 subdivisions or residential blocks, with populations exceeding 15,000 in some blocks (Census 2011). Figure 4.4 on the next page shows the residential blocks and extensions of Soshanguve.

Soshangvue has a highier propotion of female residents (51%) than men and more than 99.17% of its population are African. Although the ethnic profile of Soshanguve is mixed, Sepedi is spoken by the majority of its residents (28%) with Setswana, Xitsonga, isiZulu and Sesotho also spoken widely (Census 2011). The name 'Soshanguve' is derived from an acronym of the multiple languages spoken in the area, namely *So* (Sotho), *Sha* (Shangaan), *Ngu* (Nguni) and *Ve* (Venda) (Mahlare, 2006:29).

Region 1 has low levels of education, the highest number of people with no income in the muncipality, high unemployment, and poor living standards (Parliament of the Republic of South Africa Research Unit, 2013:11). It also has the highest population figure (28%) of all the Tshwane regions and, in 2011, it had the highest population density with 1664p/km^2 (The City of Tshwane Metropolitan Municipality, 2011:44; Tshwane Economic Development Agency, n.d).

Figure 4.4: Residential blocks and extensions of Soshanguve



Source: Adapted from Map of Soshanguve (City of Tshwane Geomatics, 2017)

The average level of education of people living in Soshanguve is ‘primary school’ and ‘some high school’ and the average montly income of households in Soshanguve, in 2016, was R4,990 (Gauteng Province Department of Roads and Transport, 2016:8). In 2010, 44% of households in Soshanguve were listed as being in the LSM 1 to 3 category (Demacon Market Studies, 2010:124). Only 38% of Soshanguve’s working age population are employed, which means that unemployment in Soshangvue is at a high 62% (Gauteng Province Department of Roads and Transport, 2016:18).

Almost 52% of households receive government grants (Ibebuike, 2013) and the majority of households that earn an income are dependend on a single breadwinner (54.8%) with only 35% having two breadwinners (Demacon Market Studies, 2010:129). When one compares the high rate of unemployment with the average income of the area one is made aware of the high incidence of inequality in Soshangvue. Most employed people work in so-called blue collar jobs in Pretoria, Rosslyn, Pretoria West, Hercules, Brits, Mabopane and Soshanguve (Demacon Market Studies, 2010:125).

In 2016, only 4% of Soshanguve’s households had access to personal transport and only 0.4% of residents had a driver’s license (Gauteng Province Department of Roads and Transport, 2016:13). Almost half of Soshanguve’s residents use taxis (33%) or buses (14%), but 36% of residents do not use public transport and prefer to commute on foot (Gauteng Province Department of Roads and Transport, 2016:25).

Similar to the rest of Gauteng, the average size of a household was 3.5 people in 2010 with 54.5% of households living on separate stands, 31% in informal dwellings on separate stands, 4.6% in informal dwellings in other people’s backyards in so-called ‘zozo’s’ (similar to ‘wendy houses’, but made from corrugated iron), 4.3% in living quarters, and 2.5% rented a flat or room on someone else’s property (Demacon Market Studies, 2010:123). Many residents live in so-called ‘RDP houses’. The term RDP refers to the Reconstruction and Development Programme and a RDP house is a cheap, government subsidised house that is made available to people who are registered as ‘indigent’. The value of an RDP home is around R100,000 to R150,000. These houses are typically small with two bedrooms, a bathroom and a small kitchen/living room. These houses all have installed pre-paid electricity meters. Figure 4.5 shows an image of a typical RDP house valued at R150,000.

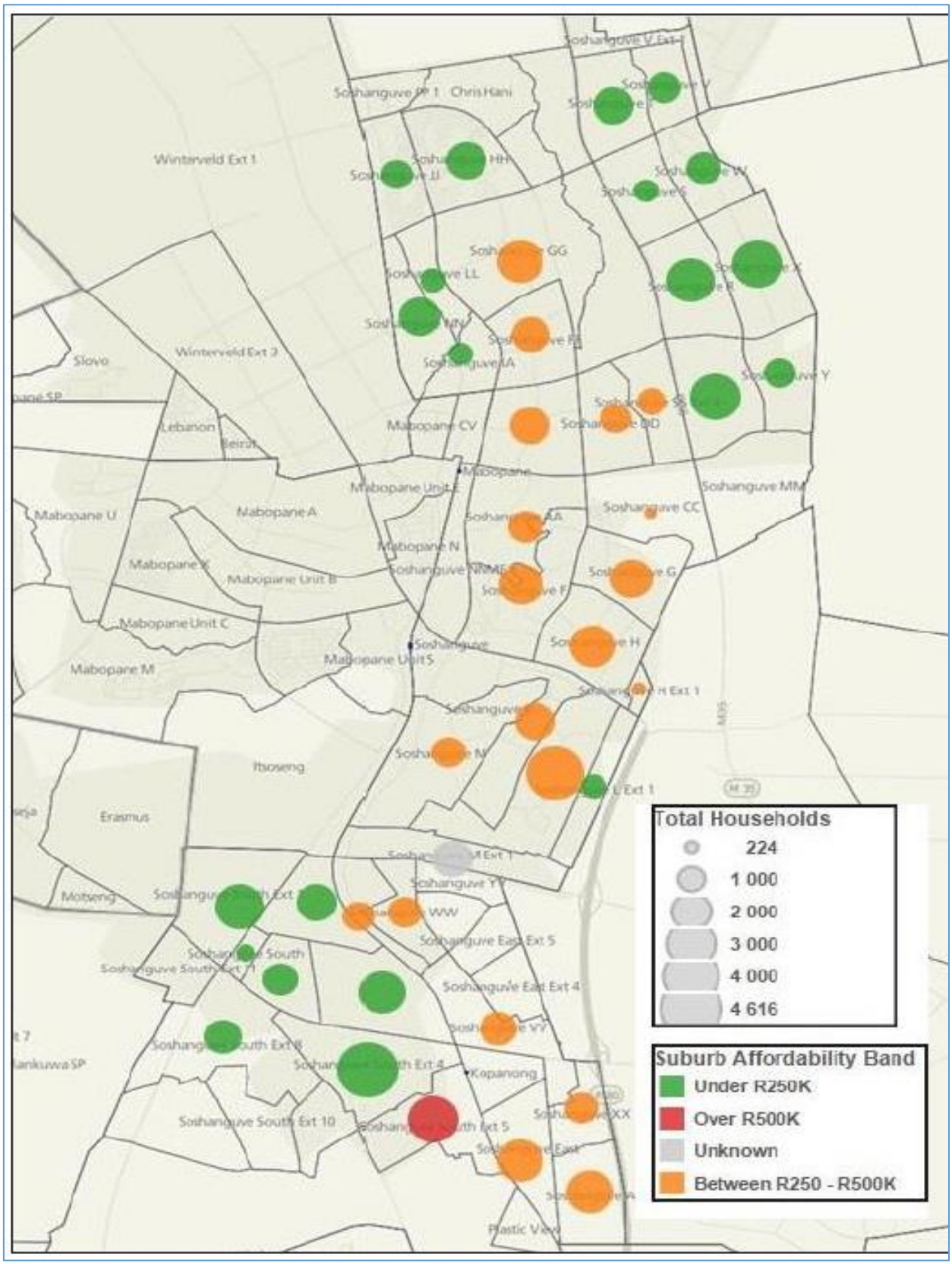
Figure 4.5: RDP house valued at R150,000 in Extension 13 in Soshanguve

Source: Mitula, RDP house

Figure 4.6 on the next page illustrates the population density as well as the affordability index of Soshanguve's residential blocks. The 'Affordability Index" is based on the results of a survey done by a property developer (Centre for Affordable Housing Finance in Africa 2012:10) and indicate the financial ability of households to afford property. The green circles indicate low affordability. The size of the circles indicate the population size of the block or extension.

Soshanguve has been neglected in past municipal policies with most funds being directed towards development in the eastern, central and southern parts of the municipality. This imbalance was corrected since 2011 and Soshanguve is the focus of new investments in infrastructure and services (The City of Tshwane Metropolitan Municipality, 2011:44).

Figure 4.6: Soshanguve average household numbers and afordability index per residential block or extension



Source: Centre for Affordable Housing Finance in Africa (2012:10)

In 2014-2015, the City of Tshwane muncipality invested R83 million towards upgrading roads and storm water systems (Ramokgopa, 2015:21) and it has dubbed the 'Zone of Choice', a strategic investment strategy to attract investment to Soshanguve (Tshwane Economic Development Agency, n.d.).

Nevertheless, because of the continous influx of new residents, the muncipality struggles to keep up with delivery of shelter and services to newcomers (Sole, 2015:66). As a result, Soshanguve consists of formal and informal areas. The formal areas, such as Soshanguve East, has established services like water, sanitation, electricity, and good roads, while the informal areas such as the settlements in Block KK, Ext 3 and Ext 14 only have basic services (focus group discussion; Sole, 2015:66).

4.3 Electrification and the 100kWh FBE of the city of Tshwane municpality

As mentioned, the national electrification rate for South Africa was 85% in 2017 (DoE, 2017:12). Gauteng province's rate of electrification differs from year to year, but in 2016 it stood at about 84% - in line with the national average (Gauteng Provincial Treasury, 2016:64). The DoE's study of 2012 reveals that the province is struggling to keep up with electricity provision to its ever expanding informal settlements (DoE, 2012:13).

The City of Tshwane's electrification rate was 88% in 2011 (Mbalo Brief Statistics South Africa 2014:7-8), but fell to 85% in 2014 (Gauteng Provincial Treasury, 2016:64). In 2011, 88.6% of households made use of electricity for lighting, 84% of households made use of electricity for cooking and 73.5% made use of electricity for space heating (Mbalo Brief StatsSA, 2014:7). Soshanguve was one of the areas which received a lot of attention with regards to electrification at the end of the last decade (The City of Tshwane Metropolitan Municipality, 2011:67). According to Nkemngu (2012) (cited by Sole & Wagner, 2016:3) 90% of the population in Soshanguve had access to electricity at the beginning of the decade. Nevertheless, only 16% of households in informal settlement areas had access to electricity (The City of Tshwane Metropolitan Municipality, 2011:123). Unfortunately, a literature review does not provide more recent statistics for electrification in Soshanguve. All newly electrified houses receive the installation of pre-payed electric meters in their homes (Sole, 2015:13).

Since the 1 July 2015, the city of Tshwane's electricity prices rose significantly from 7,8% to 12%, depending on household electrical consumption (The City of Tshwane Metropolitan Municipality, 2015:8). Table 4.1 gives an indication of the domestic tariff increases since 2015. As can be seen, households that consume less than 100 kWh a month only pay a 7.8% increase in price. This is in line with the DoE's inclined block tariff policy.

Table 4.1: Tshwane domestic electricity tariff increases

Tariff blocks	c/kWh 2014/15	c/kWh 2015/16	% increase
Block 1 (0 – 100 kWh)	113,14	121,96	7,8
Block 2 (101 – 400 kWh)	129,08	141,70	9,8
Block 3 (401 – 650 kWh)	137,78	154,60	12,2
Block 4 (>650 kWh)	147,23	165,20	12,2

Source: The City of Tswhane Metropolitan Muncipality (2015:5).

A household that consumes less than 100kWh a month will therefore pay little over R1 per kWh which brings their electricity bill to roughly R122 a month (The City of Tshwane Metropolitan Municipality, 2015:6). A household that spends more than 300 kWh on electricity will pay about R1,50 per kWh resulting in a bill of R425 per month (The City of Tshwane Metropolitan Municipality, 2015:8). The muncipality's total capital budget for 2016 was R4 billion of which the bulk was allocated towards service delivery and infrastructure development. The budget for electricity provision was R157 million in 2015 (The City of Tshwane Metropolitan Municipality, 2015:8).

The City of Tshwane grants a FBE amount of 100kWh to households that qualify as 'indigent' (The City of Tshwane Metropolitan Municipality, 2011:65). At the start of the FBE rollout, the city provided the FBE to every household that applied for it, regardless of household income or electricity usage. It did not use the national criteria of 'indigency'. As a result, rollout was uneven and many of the poorest households which should have benefited from this free electricity did not receive it, whilst some households who strictly did not qualify, received it. This led to inequality and, upon review; the city of Tshwane changed their policy by adopting the Department of Social Welfare's registry of 'indigent' households as a guideline (Makonese *et al,* 2012). Tshwane municipality now gives 'indigency' status to households

that live in shacks, households whose members are unemployed or who do not have formal employment, and pensioners (Sole & Wagner, 2016: 7). Households that are registered as 'indigent' receive free waste and sewage removal, some free water per month, and are exempt from rates and taxes (City of Tshwane Metropolitan Municipality). As with its FBE, the city of Tshwane gives generous amounts of free water to its poor. Nationally, 'indigent' households qualify to receive up to 6kl of free water. Tshwane municipality gives 12kl of water free (The City of Tshwane Metropolitan Municipality).

In 2010, 11,9% of households in Tshwane municipality were registered as indigent. According to a municipal report of 2011, 100% of these households received free basic services (The City of Tshwane Metropolitan Municipality, 2011:126). Consequently, 82,100 households had access to the 100kWh free electricity and the 12kl water (The City of Tshwane Metropolitan Municipality, 2011:123). It is unclear how many households in Soshanguve had been registered as indigent or receive the FBE. The residents of Soshanguve call the FBE 'POP' ('poorest of the poor') (focus group discussion; Sole & Wagner, 2016:8).

In 2010, the city of Tshwane initiated a Solar Water Heating project which aimed at providing these systems to indigent hosuehlds in four townships, namely Mabopane View, Ga-Rankuwa View, Nelmapius, and Soshangvue. It had the target of installing 60,000 Solar Water Heaters (SWHs) by 2015. In its first year, it installed 15,000 SWHs. Various third-party installantion companies where contracted in each area (Curry *et al,* 2017:77). Soshanguve township received 300 SWHs between 2009 and 2010. The installation was sponsored by Tshwane University and other donors. A study of Curry *et al* (2017), reveals that the maintenance of these SWHs was neglected by households who did not know how to maintain it as well as the original installantion company. Of the fourteen households in Soshanguve that formed part of the Curry *et al* (2017) study, all households reported a technical fault and 57% of the respondents abondened the use of their SWHs due to water leakages and lack of water suppply. It seemed households did not know how to contact the installation company (Curry *et al,* 2017:78). Nevertheless, despite this bad start, SWH had become a sought after commodity in Soshanguve. SWHs are so popular, that those who received their RDP houses prior to the programme have voiced their unhappiness (focus group discussion).

4.4 Multiple fuel use in Gauteng and Soshanguve

The Department of Energy's 2013 report reveals that Gauteng province has the second highest single use of electricity (63%) for cooking after the Western Cape, and the lowest use of multiple energy use (27%) of all the provinces (DoE, 2013:35). Multiple energy use for cooking in Gauteng is mostly a combination of electricity and kerosene (9%) and electricity and gas (8%). The electricity and gas combination seem to be a phenomenon employed by higher LSM households to cope with load shedding (DoE, 2013:35).

The choice of using electricity as a single source of energy for space heating in Gauteng is also the highest of all formal urban areas, namely 59%. Only 6% of households in Gauteng use a combination of firewood and electricity for space heating and only 4% use a combination of kerosene and electricity (DoE, 2013:38).

Also, according to the DoE's thermal efficiency approach, which measures energy poverty according to the condition of houses, Gauteng, along with the Western Cape, experience the lowest incidence of thermal inefficiency of households (DoE, 2013:50). People who live in informal dwellings or shacks, experience the highest incidence of household thermal inefficiency, even more so than people who live in traditional dwellings. It is postulated that these households have a greater need to heat their spaces in winter and therefore have a higher need for thermal energy sources. Nevertheless, it seems that households in Gauteng, proportionally to other provinces in the country, do not have a high incidence of thermal inefficiency (DoE, 2013:49). These findings, however, obscure the reality of the lives of the poor in Gauteng and are an indication of the high incidence of inequality in the province.

Kimemia and Annegarn (2011) conducted a study on the incidence of biomass use in the non-electrified informal settlement of Setswetla in Alexandra Township in Gauteng. Their study reveals the importance of traditional fuels for very poor urban households that do not have access to electricity. According to their study (Kimemia & Annegarn, 2011:384), 99% of the households that was sampled in Setswetla were reliant on kerosene for lighting and cooking with 92% of households using it for cooking in a wick stove (primus stove) and 34% using kerosene for space heating. The popularity of kerosene seemed to be a result of the fact that both the fuel and the wick stove is relatively cheap and widely available in the area.

Wood fuel is also an important source for space heating in this community with 66% of households using it for this purpose and 24% using it for cooking. Kimemia and Annegarn's (2011: 385) study revealed that households in Setswetla could not afford to buy large cast iron coal stoves which are popular in the older areas of Alexandra and neighbouring Soweto. Respondents also indicated that the nearest coal depot was 2.5 km away and that coal was more expensive then firewood. As both fulfilled the same functions, they preferred to use wood (Kimemia & Annegarn, 2011:385-386). As a result, coal is used by only 20% of households.

Many households (58%) appear to have access to free fuelwood from surrounding areas such as Malboro and Wynberg, with only 32% of respondents buying fuelwood from vendors. Mostly women were responsible for collecting fuelwood (59%). They would spend approximately one to two hours searching for fuel and make about two trips in a week. In winter, more trips must be made as there is an increased need for fuelwood for heating purposes. Wood collectors would often sustain injuries from splinters or, as has been the case, they return home empty-handed due to many other collectors clearing the area of suitable wood (Kimemia & Annegarn, 2011:385).

In the study done by Sole (2015:3) in Soshanguve, participants used electricity, wood, kerosene and coal to meet their energy requirements. Wood fuel is used to prepare traditional meals with long cooking times, and because people prefer the taste of food prepared over a wood fire. As Soshanguve is surrounded by rural areas, wood fuel is readily available and costs nothing but the time it takes to collect it (Sole, 2015:181, 182).

Sole's (2015:5) study shows that the rise in electricity prices forced women to rely on traditional fuels, such as wood and kerosene, more for the preparation of food. Higher electricity prices were especially prohibitive for households where no members are employed. One participant said:

> When I started working and living here, electricity worth R100 it was about 300 and something units back then, now R100 electricity you won't even get 100 units, its 50 something or 60 something units. Electricity today is not the same as in the past … in terms of units [it is] minimised to become less. When I use electricity, I feel like I am using it over I see it quickly

> finishing up and it is consuming time. …Electricity lasts me longer when I use other fuels as well (Sole & Wagner, 2016:5)

As are result participants use various strategies to make electricity last longer. For instance, they would use electricity to cook light meals like rice, gravy, and chicken feet which cooks fast, use electricity for lighting and powering appliances, especially television, but use kerosene, gas, and wood to satisfy their other energy needs. They also limit the number of times they cook with electricity. For instance, households prefer preparing bulk meals – which can be stored and consumed over several days – and also prefer canned goods over perishable goods (Sole & Wagner, 2016:5).

As one participant also says:

> You think about time and decide to switch it off quickly even when the food is not properly cooked the way you would want it to be [and you] end up looking and counting the hours it took to cook. [So] yes they will cook, but you must know that the electricity will also be finished [laughing]. We are starting to run away from using electricity much in that context. (Sole & Wagner, 2016:5).

As already mentioned in Chapter 3, Sole's (2015) study also reveals that culture plays an important role in the choices women make with regards to the way they use energy. She says that the participants' current fuel use is informed by their childhood experiences in rural areas. In these areas their mothers would cook with wood and dung. Traditional cooking culture was based on using what was available, and the participants use this approach in urban areas (Sole & Wagner, 2016:5)

Some of Sole's (2015) participants were recipients of the FBE. They indicated that they were satisfied with it and felt that it lasted a reasonable amount of time, but some argued that it was insufficient. The consensus was that the FBE lasts longer if it was used in conjunction with other fuels (Sole & Wagner, 2016:5). Sole's (2015:6) study also reveals that the FBE made at least one significant contribution towards delaying a participant's decision to 'switch' back to using multiple fuels when electricity prices increased.

With regards to participant feedback over how government can improve their ability to meet their energy needs, participants indicated that they would like an increase in the FBE (Sole & Wagner, 2016:5).

4.5 Conclusion

This chapter discussed the study area, a township called Soshanguve, situated 25km north of the capital city of Tshwane that is part of the smallest but wealthiest province in South Africa. Like the rest of Gauteng, the City of Tshwane struggles with high inequality and the township of Soshanguve has great disparities in income, mostly as a result of the continuous influx of unskilled migrants from rural areas in other provinces and other African countries.

Soshanguve has received an increased focus in service delivery and investment in the previous decade to such an extent that its electrification rate was 90% at the beginning of the decade. This was in conjunction with the roll-out of the 100kWh FBE to households who quality as indigent. These are households who reside in shacks, whose members are unemployed or who do not have formal employment or are pensioners.

At the beginning of the decade, the city of Tshwane also initiated the roll-out of a Solar Water Heating project to demarked areas of which Soshanguve was one. Despite a lacklustre start, solar geyser have become a sought after commodity in the region.

Next to electricity, kerosene is the most popular energy source used for cooking in Gauteng. This is true of poor households and the fact that Gauteng has the lowest rate of multiple energy use in the country, obscures the reality of fuel use in poor areas. Sole's (2015) study shows that the use of multiple fuels is a necessity in Soshanguve as the price of electricity has increased dramatically and households that receive the FBE must use multiple fuels to ensure that their FBE lasts as long as possible.

CHAPTER 5
RESEARCH METHODOLOGY

5.1 Introduction

The first part of this chapter will explain the sampling procedure and techniques that were used during the qualitative part of the study. Informal, semi-structured and structured interviews were used for data gathering purposes during the qualitative part of the research process. When the data analysis for this study was completed a focus group discussion was held with the field assistants to debate and discuss the findings.

The second part of the field research consisted of a survey which generated a sample of sixty households, thirty of which had access to electricity but do not receive the 100kWh subsidy and thirty who do.

The second part to this chapter explains the sampling and data collection techniques that was used during the quantitative part of the study. Topics discussed are the survey questionnaire, the selection and training of field assistants, the sampling criteria and the problems experienced during the sampling process.

5.2 Qualitative sampling and data collection techniques

5.2.1 Interviews

The researcher started by compiling a list of preliminary open-ended questions that could be used to start conversations with respondents. The questions were based on the information gained during the literature review, but also contained questions asked during the 2012 survey of the Department of Energy (DoE, 2012). The researcher approached a friend who lives in Soshanguve who agreed to act as interpreter and field assistant. She advised the researcher to wait until after the municipal elections were held on the 3rd of August 2016 as she was concerned that the researcher's presence in Soshanguve would be construed as a political one.

The researcher and the field assistant travelled to Soshanguve by taxi and the researcher was introduced to the assistant's family reside in Block Y. The day was spent getting to know her family and familiarizing herself with the neighbourhood. The researcher also conducted a semi-structured group interview with the main breadwinner, his partner and daughter. The researcher was given a detailed account of their energy use, as well as other aspects of their lives. The researcher was then introduced to a neighbour, Mrs. 'Mkhize', with whom she also conducted a semi-structured interview. The researcher and her friend then walked through the neighbourhood to interview another neighbour who agreed to an interview that day, but who was unfortunately not home. It was the researcher's intention to first get a sense of place and establish good relationships with the field assistant's neighbours. It was important for the researcher to keep the interviews informal and relaxed, therefore a recording device was not used.

Unfortunately, after the researcher's visit, the security situation in Soshanguve deteriorated because of discontentment in the area over a squatter settlement issue and the researcher was advised by her field assistant not to travel to Soshanguve. Some residents were also under the impression that the researcher represented a specific political party, which was unpopular after the municipal elections.

As a result of this, the researcher decided to follow an alternative data sampling strategy. The researcher drew up a structured interview schedule with open-ended questions and asked her field assistant to conduct the interviews. She was asked to only conduct interviews with her closest neighbours and people she knows well if they fulfil the criteria of earning below R4,000 and do not use electricity illegally. She filled in the responses from her participants and every interview was followed up by a thorough debriefing session. In these sessions she would report back to the researcher and make suggestions for future questions. She also gave insight into the lives of respondents and explained their cultural elements and livelihood strategies. The interview schedule would be adjusted following each session in order to test nascent variables and phenomena. Extracts from the final interview schedule can be seen in Annexure A on page 219.

Note that the schedule consisted of six parts. They were as follows:

- Part A: Demographics and household profile.
- Part B: Lighting.

- Part C: Cooking.
- Part D: Space and water heating.
- Part E: Appliance use.
- Part F: Fuel affordability, fuel choice, vulnerability, energy poverty, and suggestions for government.

Throughout the process, the field assistant took pictures of the energy sources and relevant appliances. She conducted three interviews with respondents in her neighbourhood who have access to electricity but do not receive the FBE, two interviews with neighbours who receive the FBE, and two interviews with people who live elsewhere in Block Y that also receive the FBE. She also did follow-up interviews with her family and the respondents that she approached in the beginning at a later date. The researcher decided that four interviews in each category was sufficient for the scope of her study.

After analysing the data from the qualitative study, the researcher tried to verify the accuracy of the data in the interest of checking the reliability of the information by contacting the participants on their mobile phones. This was unsuccessful. Instead, the field assistant returned to each respondent and asked them to sign a copy of their responses if they were satisfied that it was accurate.

This was not just in the interest of checking the accuracy and reliability of the data, but also to satisfy the ethical requirements of the study, as respondents could decide whether they were happy with the interviews being published. As their pseudonyms where already included in the written report, they also had peace of mind that their anonymity was assured.

The largest contribution of the qualitative part of the research was that it enabled the researcher to become aware of patterns in the data that enabled her to construct the correct questions to be asked during the survey. It also provided valuable insights into the complex household energy decision environment, and the struggle of households in meeting their basic needs.

5.2.2 Focus group discussion

After the data analysis chapter was finalized, a focus group discussion was held on 3 November 2017 to communicate the results of the study with the field assistants. Six of the eight field assistants were able to attend the meeting. (Please see section 5.3.2 with regards to the selection of field assistants)

The aim of the group discussion was to discuss the findings and certain anomalies and patterns in the data that was interesting. The field assistants, through their knowledge of the area, were able to shed light on certain patterns in the data. Findings that were anomalous to them sparked debate. It was clear during this debate that the experiences of the HDE was not the same for field assistants. The results of the focus group discussion will add to the discussion in the following Data Analysis chapter.

5.3 Quantitative sampling and data collection techniques

5.3.1 The survey questionnaire

The experience and insights gained during the qualitative part of the research led to the readjustment of the interview schedule and the finalisation of the survey questionnaire. The survey questionnaire followed the same design of the interview schedule and contained many of the most important questions asked during the interviews. However, it was adapted and operationalized for data analysis with IBM's SPSS software.

Where the interview schedule had many open-ended questions, the survey questionnaire was drawn up to test the most important variables identified during the field research. A category for 'Other' was created as standard practice. The questionnaires did not contain options like 'not applicable', 'don't know' or 'not sure' as the researcher did not want to encourage respondents to select these options. Extracts from the final interview schedule can be seen in Annexure B on page 225.

The researcher tried to ensure that all questions were clear and understandable to those who did not have L1 English proficiency. At the risk of making the questionnaire dense, some questions were also explained or expanded on *in situ*. As with the qualitative part of

the research, the researcher conducted a pilot test of the survey before the final questionnaire was rolled out.

The field assistants informed the respondents in advance that they did not have to answer a question if they felt unsure or uncomfortable about it. In practice, however, this seldom occurred.

There were two questionnaires: one for non FBE households and one for FBE households. The former was fifteen pages in length. The questionnaire for FBE households was much longer and contained 282 questions and 800 variables. The researcher tried to scale down the content to focus on the main objectives of the study, but the focus of the study at that time was broad as it included not just all aspects of household energy use but also questions about load-shedding and the impact of higher energy prices. Note that the questionnaires only differed in terms of the fact that certain categories had questions that were specific to the status of the subsidy. Please see Annexure B on page 224 for extracts of the survey questionnaire that was filled in by households who receive the FBE .

In the end, the survey was completed with the help of eight field assistants and sixty respondents. The sample consisted of thirty electrified non FBE households and thirty FBE households. Respondents were not financially compensated for their participation.

5.3.2 Selection of field assistants

Originally the researcher planned to gather data via a telephone with residents of Soshanguve and who are enrolled in Unisa's College of Human Sciences. The researcher applied for the list of students from the university registrar's office in August 2016. A total of 750 students were enrolled in the College of Human Sciences and resided in Soshanguve. The researcher then used the 2012 map from the Centre for Affordable Housing Finance in Africa to locate the areas which are considered 'low-income residential areas' in Soshanguve (see Figure 4.6 on page 90 in Chapter 4).

According to this map, the 'low-income residential areas' of Soshanguve are mostly located in Soshanguve North, Block LL which forms part of Soshangvue North and most extensions in Soshanguve South. Soshaguve East seemed to be a middle class area. Out of the total

of 750 students, only 192 students lived in these areas. This included 143 students from Soshanguve North and 49 students in Soshangvue South.

It became apparent that a telephone survey was unsuitable given the length of the questionnaire. The best option was to change the sampling technique by contacting students to request their participation by filling In the questionnaires themselves electroniclly. The only two criteria were that the questionnaire had to be completed by households earning less than R4,000 a month and do not use electricity illegally.

The researcher initiated the sampling process by contacting the students residing in Soshanguve North. The researcher decided to focus on female students as they where in the majority and were enrolled in courses such as social work and health sciences. The researcher thought that the topic might be of interest to these students.

Of the thirty students the researcher spoke to in Soshangvue North, twenty-five students agreed to complete a questionnaire. In the end, however, only seven students completed the questionnaire. Some students were unwilling to print the questionnaire, encountered difficulties in accessing it through mobile devices, or were put off by the length of it. All the students who responded were social work and health science students.

As so few people responded, the researcher realised that this sampling technique would not produce a large enough sample. The researcher therefore decided to invite these student respondents for an interview. Here they were asked if they were willing to act as field assistants. Four of the seven students accepted the offer. The researcher then also contacted one student in Block LL, one in Block L and, two students in Soshanguve South who had good academic records and who were already in their final practical year in the Social Work course. These students already passed a course in research and research ethics and were thus well suited for field work. Along with the initial field assistant, the researcher now had eight assistants at her disposal.

As the researcher needed thirty households in each category, careful management of the sample process was needed to ensure that field assistants did not oversample a specific category.

The total sample consisted of sixty households of which nineteen households from each category reside in Soshanguve North and eleven in each category reside in Soshanguve South. Take note that Block MM and LL are part of Soshanguve North while Block G, H, L, and M are part of Soshanguve South. Note that no households were sampled in Soshanguve East as this area is not seen as a low-income area according to the Centre for Affordable Housing Finance in Africa (2012).

5.3.3 Training of field assistants

After the field assistants were appointed it was necessary to train them. Field assistants were trained individually. They were briefed on the objectives of the study, the questionnaire, and other aspects of the study. In turn, they informed the researcher about cultural elements and local terms in Soshanguve. For instance, many people in Soshanguve refers to the 'wonderbag' (see chapter 6, page 132 for a definition) as a 'solar cooker'.

The field assistants from Block LL and Soshangvue South did not participate in the original sampling procedure. In their case the researcher administered the questionnaire to them as if they were respondents. This also afforded the researcher the opportunity to observe the survey in practice. It became apparent that the FBE questionnaire was overly long and dense.

It also became clear from these initial responses that Soshangvue South had a slightly different HDE than households in Soshangvue North. For instance, households in Soshanguve North have easy access to firewood from neighouring Hammanskraal and have limited access to coal. Households in Soshangvue South, have easier access to coal and experience higher prices for firewood. As a result, the questionanire also had to include new variables that were ommitted from the original questionniare.

All field assistants were briefed on the ethical issues pertaining to field research and the importance of making sure that respondents were aware of their rights. It was also necessary for the field assistant to inform their respondents that the study was for academic purposes, as one respondent who filled in a questionnaire in the intitial sample strategy, was under the impression that the survey was part of a government study. Another respondent in the inititial sample procedure thought that the survey was for a specific political party.

5.3.4 Sampling Criteria

The fields assistants had to follow certain criteria to guide them with their sampling. The most important criteria were the following:

- The sample household must not earn more than R4,000 a month.
- Respondents had to be known to the field assistants to such an extent that the field assistant knew whether they used electricity illegally or not.

Reasons for the latter are as follows:

1. Assistants are unlikely to know if the household is accessing electricity illegally or not if they are unknown.
2. Safety.
3. Greater willingness to participate.
4. Knowledge of their electrification and or FBE status.

5.3.5 Problems experienced during the sampling process

One of the field assistants disregarded the second criterium. She used her contacts at a welfare clinic to interview people there. This resulted in her not knowing whether or not these respondents where using electricity illegally. In two cases respondents admitted that they access electricity illegally. The information in many of her questionnaires had contradictory answers. Consequently, questionnaires administered by this assistant were discarded.

Some of the assistants decided to conduct five questionnaires on each household category, but had trouble finding enough respondents. In order to honour their initial commitment, they decided to approach households they did not know. This resulted in two difficulties:

a) One field assistant approached two males outside their shack. She asked them if they would participate, but when they saw the researcher's name on the questionnaire, they asked her if she was doing research on behalf of a particular political party. The men agreed to do the survey but their answers were extremely negative and they were aggressive towards the assistant.

b) The quality of the data generated from these questionnaires done differed vastly from those completed by known respondents.

The ommission of data and mistakes in some of the questionnaires meant that the field assistants had to go back to verify some of the data in the questionnaires. This was a great financial burden and also meant a huge loss of time for the researcher.

5.3.6 Validity and reliability of data

According to Joppe (2002) (in Golafshani, 2003:598): 'validity' in research refers to how truthful the research results are and whether it truly measures which it had intended to measure". 'Reliability' refers to whether the sample population had been accurately represented and whether if the methodology, if used elsewhere, could be replicated and produce similar results (Joppe 2002, in Golafshani, 2003:598). In other words, the researcher must take care that the research process generates data that allows for precision, credibility, and transferability.

The researcher kept these issues in mind throughout the research design and implementation process. These issues presented some difficulties during the qualtiative part of the study as the researcher was only able to conduct two of the interviews and had to rely on her initial field assistant to ensure the validity and reliability of the data collected. To ensure this, intensive briefing sessions followed each interview and the interview schedule was continiously adapted to allow for the testing of new variables. All participants signed their write-ups and informed the assistant that it was accurate.

In the quantiative part of the research, the researcher relied on field assistants to generate reliable and valid data. The questionnaire, however, was designed in such a way that irregularities in data could be easily spotted. For instance, some questions were similar and if there was widely differing results, it was queried by the researcher. Some assistants admitted that the wrong box was ticked. The results of each questionnaire from a specific assistant would also be checked to see if there were similar results for certain questions.

In the end, a total of 15 questionnaires was discarded. Findings from the qualitative and the quantitative data were compared to uncover similarities in the data. As a result the researcher is confident that the data for this study is valid and reliable.

5.4 Data Analysis and Presentation

5.4.1 Qualitative data

No computer software was used to analyse qualitative data. The researcher did an in-depth explanatory write-up of the answers that the participants gave to the interview questions. The write-up was done according to the categories of household energy use, namely lighting, cooking, space and water heating and appliance use. The researcher focused on elucidating the patterns of energy use from the data and used the ECHDE as a guiding framework (see chapter 6 for data analysis).

5.4.2 Quantitative data

The researcher used IBM's SPSS package to capture and analyse the data. When it was impossible to generate certain data with SPSS, the researcher generated data manually using MS Excel.

5.5 Conclusion

This chapter described the research methodology used in the study. It consisted of both a qualitative methodology through informal, semi-structured and structured interviews and a focus group discussion as well as a survey of sixty households (thirty FBE households, thirty non FBE households). The data from the thirty households that do not receive electricity were excluded from the study due to a change in scope.

In the discussion of the qualitative part of the study, the creation and implementation of semi-structured interviews was explained. The sample process and steps taken to ensure reliability and validity of data were described.

In the discussion on the quantitative part of the study, the interview schedule as a basis for the survey questionnaire was described. The revised sampling process and the recruitment and training of field assistants were also described. Certain problems that was experienced during the sample process were also discussed.

Lastly, the issues of validity and reliability were discussed and the researcher made the point that the necessary steps was taken to ensure the validity and reliability of the data for the study.

Chapter 6
Data Analysis

6.1 Introduction

The data from the quantitative and qualitative research will be examined in this chapter. The researcher will firstly introduce the participants of the qualitative part of the study and describe their household opportunity set. The household opportunity set and demographics of the households from the survey will also be detailed. Note that the participants that do not receive the FBE is ‘Mrs. Zondi’, ‘Mrs. Mazibuko’, ‘Mr. Mathebula’ and ‘Mrs. Mkhize’, and participants that do receive the FBE is ‘Mrs. Magolego’, ‘Mr. Zuma’, ‘Mrs. Mosimane’ and ‘Mrs. Khoza’. Note that this is not their real names but pseudonyms. For easy reference, their subsidy status in this discussion will henceforth be referred to in brackets behind their name as either ‘FBE’ or ‘No FBE’.

The chapter aims to compare data from households that receive the FBE and those that do not. Data from the interviewees will be triangulated with data collected though the survey.

The chapter will address the three main objectives of the study, namely:

1. To investigate the impact of the 100kWh FBE on meeting poor urban household needs for lighting, cooking, space and water heating and powering appliances
2. To establish the impact of the 100KWh FBE on the incidence of multiple fuel use and ‘fuel stacking’ for households who receive it.
3. To establish the impact of the 100kWh FBE on household seasonal poverty

It will also look at the consequences of energy poverty in general and the response of the respondents when asked what they think government can do to assist them in meeting their energy needs.

6.2 Household opportunity set and demography

6.2.1 Household opportunity set - Interviews

6.2.1.1 Mrs. Zondi (No FBE)

Mrs. Zondi is a middle-aged Zulu speaking woman who is married and comes from the urban part of Mabopane, where she lived in a traditional house. Her family has been living in Soshanguve for more than five years and has a fully electrified, two bedroom RDP house in Block Y. The Zondi's children are all grown up and have moved out. Although Mr. Zondi is the main breadwinner, Mrs. Zondi receives a small government grant. Mrs. Zondi did not want to disclose their family's income.

6.2.1.2 Mrs. Mazibuko (No FBE)

Mrs. Mazibuko is a Zulu speaking woman in her mid-forties who lives in Block Y and is a neighbour of Mrs. Zondi. She does not have an RDP house, however, instead she lives in a one-bedroom shack with a kitchen and dining area and no bathroom. Mrs. Mazibuko lived in a traditional house in rural Makapane three years ago before moving into her current dwelling. Mrs. Mazibuko's house has a legal electricity connection. She lives alone and is self-employed. Her total income is less than R1,500 a month, and she did not know of the existence of the FBE at the time of the interview.

6.2.1.3 Mr. Mathebula (No FBE)

Mr. Mathebula is a sixty-two-year-old Zulu speaking man and is a neighbour of Mrs. Zondi and Mrs. Mazibuko. Mr. Mathebula and his family live in an RDP house. He originally comes from a rural area in Kwazulu-Natal where he lived in a traditional house. He has been living in Soshanguve for fifteen years. When Mr. Mathebula arrived in Soshanguve he initially lived in a shack until he received his RDP house in 2010. Mr. Mathebula is married and has four children and a granddaughter who lives with him. Only one of Mr. Mathebula's children is under the age of 18 and goes to school. Mr. Mathebula is the main breadwinner and Mrs. Mathebula and one of his daughters receives a child support grant. His total household budget is between R1,500 and R2,000.

6.2.1.4 *Mrs. Mkhize (No FBE)*

Mrs. Mkhize is also a neighbour of Mrs. Zondi, Mrs. Mazibuko, and Mr. Mathebula. She is a middle-aged woman who has recently been widowed. She lives in a well-appointed middle-class home with modern fittings, a four-plate electric stove and other modern conveniences. Mrs. Mkhize's husband did well financially and consequently they had been able to live comfortably whilst he was alive. His passing has left her in a dire financial situation, as he did not make sufficient provision for her. Mrs. Mkhize was uncomfortable with answering detailed questions about her income and energy use.

6.2.1.5 Mrs. Magolego (FBE)

Mrs. Magolego lives in Block Y in Soshanguve and is also a neighbour of the other participants. She is a Pedi speaking woman and originally comes from a rural area close to Mafikeng in North West province. Mrs. Magolego is unmarried and has a sixteen-year-old daughter who still goes to school and lives with her. Mrs. Magolego moved into her RDP house five years ago and receives the FBE. She heard about the FBE through the ward councillor and registered two months later. Mrs. Magolego is employed as a domestic. She earns between R1,000 and R1,500 a month with the addition of a child support grant.

6.2.1.6 Mr. Zuma (FBE)

Mr. Zuma is also neighbour to the other participants in Block Y and is a middle-aged man who has a partner and three children. The Zumas are a Zulu speaking family and Mr. Zuma originally comes from Hammanskraal, a rural area adjacent to Soshanguve. Two of their children still live with them, a daughter, aged thirty-three, who also has a daughter of her own (aged five), and a son, aged fifteen. Mr. Zuma's seven-year-old grandson – by his eldest son – also lives with them. Mr. Zuma's youngest daughter has moved out of the house at the beginning of 2016 and lives in neighbouring rural Winterveld but comes back regularly to visit and dine there. His partner's sister also lives with them. As a result, the household consists of seven people.

The Zuma family has been living in Soshanguve since 1992. They first lived in a five-roomed shack with no electricity and a pit latrine. The shack was electrified in 1999. The family were

informed of the FBE through their ward councillor. They received ‘indigency’ status two months after applying for it and have been receiving the FBE since 2000. Mr. Zuma was unemployed at the time. In 2010, they moved into their new RDP house. This accommodation is too small for their family and as a result they have added more rooms. Mr. Zuma plans to rent out the rooms for an extra income when his children leave home.

Mr. Zuma is the main breadwinner of his family. His son and daughter receive child support but this only covers crèche fees and other childcare expenses and does not contribute to the household income. Mr. Zuma’s partner used to clean houses four days a week but recently lost two of her regular jobs. She tries to make up for this lost income by minding a small baby for a fee some days of the week. Mr. Zuma and his partner earn between R2,000 to R2,500 a month.

6.2.1.7 Mrs. Mosimane (FBE)

Mrs. Mosimane is a Xitsonga speaking woman who is married and lives in Block Y with her husband and two children. Her eldest daughter is eighteen years old and has graduated from high school, and her son is five years old. She originally comes from Mafikeng in the North West province where she met and married her husband in 1986. The family moved into their RDP house in Soshanguve in 1992. They were made aware of the FBE from the municipality in 2009 and registered after six months. Mr. Mosimane earns a small income, while Mrs. Mosimane earns an income as a health care worker. They earn roughly R3,000 a month.

6.2.1.8 Mrs. Khoza (FBE)

Mrs. Khoza is a SiSwati speaking woman who lives in Block Y with her two daughters aged twenty-three and thirty-two. The eldest daughter has two small children. Mrs. Khoza married in Swaziland in the 1970s and their family moved to Soshanguve in 1993. They first lived in a shack that benefitted from a government upgrade scheme, so the shack had electricity when they moved in. They applied and received their FBE in 2003. Since Mr. Khoza’s death in 2005, Mrs. Khoza has been her family’s sole breadwinner. She works as a cleaner at a community organisation and washes clothes for an additional income. Her eldest daughter receives child support from the government, but this does not contribute towards the family

income. They moved into their RDP house only a few years ago. Mrs. Khoza earns between R 2,500 to R3,000 a month.

6.2.2 Household opportunity set and demography - Survey

Most households in the sample are located in Soshanguve North (63%). Despite the overrepresentation of this area, the sample is spread out evenly across the regions between the categories as can be seen in Table 6.1.

Table 6.1: Location of sample households

		Electricity	FBE	Total
	Soshanguve North	19	19	38
	Soshanguve South	11	11	22
Total		30	30	60

Most of the respondents in this survey are female (74%). Again, this ratio is spread evenly across categories. Table 6.2 shows the gender of the respondents according to subsidy status.

Table 6.2: Gender of Respondents

		Electricity	FBE	
	Male	7	9	16
	Female	23	21	44
Total		30	30	60

Table 6.3 shows the sizes of households in the survey. As can be seen, the size of households that receive the FBE is slightly larger than households that do not receive the subsidy, with 74% having five or more members compared to 50% of households that do not receive the subsidy. In the same vein, 50% of households that do not receive the subsidy have household sizes smaller than five members compared to 27% that receive the FBE.

Table 6.3: Household sizes and FBE				
	Household members	Electricity	FBE	Total
	2	4	0	4
	3	5	3	8
	4	6	5	11
	5	2	6	8
	6	6	6	12
	7	2	5	7
	More than 7	5	5	10
Total		30	30	60

This is quite significant, as it would make sense that households that have many members would experience a higher degree of energy poverty, especially if they are dependent on a sole breadwinner. Table 6.4 shows household income across categories.

Table 6.4: Household income vs. electricity supply				
	Income Bracket	Electricity	FBE	Total
	R0 to R500	0	1	1
	R501 to R1,000	6	5	11
	R1,001 to R1,500	7	7	14
	R1,501 to R2,000	3	4	7
	R2,000 to R2,500	6	5	11
	R2,501 to R3,000	3	4	7
	R3,001 to R3,500	2	1	3
	R3,501 to R4,000	3	3	6
Total		30	30	60

As can be seen from Table 6.4, income per household is evenly spread across categories. When one looks at the amount of money available *per household member* (Table 6.5) it become obvious that larger household sizes affects the income burden of households that receive the FBE with only a third of households that receive the FBE having more than R400 available per person compared to half of households that do not have the FBE. This difference is statistically significant, and it has an impact on the results of the study. One household that receive the FBE, for instance, suffers from acute poverty with each member

having only R80 available per month (Category 0). Also, two of the households that do not receive the FBE have low income burdens of between R1,001 to 3,000 per person. This is because these households have only two or three members. Throughout the study it is obvious that the data from these households reflect higher living standards, higher satisfaction with the reception of electricity, less use of 'dirty fuels' and a conception of fuels as 'affordable'. When viewing comparison of statistical data throughout this study, this variance in income burden between the two categories need to be kept in mind and will be pointed out where relevant.

Table 6.5: Household Income burden category

	E	FBE	
0 - R0 to 100 p/p	0	1	1
1 - R101 to 200 p/p	4	4	8
2 - R201 to 400 p/p	11	14	25
3 - R401 to 600 p/p	9	6	15
4 - R601 to 800 p/p	1	4	5
5 - R801 to 1,000 p/p	3	1	4
6 - R1,001 to 3,000 p/p	2	0	2
Total	30	30	60

Most of the respondents across both categories have been living in Soshanguve for longer than ten years with half living in RDP houses and fifteen living in brick houses that they have either bought or built themselves (see Table 6.6 on next page). Only one household that receive the FBE lives in a shack compared to five shack-dwelling households that do not receive the FBE. In general, most households that receive the FBE are therefore living in houses that are well insulated. One would expect the six households that live in shacks to have a greater need for space heating in the winter as shacks are badly insulated.

Table 6.6: Types of houses				
		Electricity	FBE	
	Room	1	0	1
	Traditional house	1	0	1
	Shack	5	1	6
	RDP house	14	17	31
	Bought bond brick house	6	9	15
	Other	3	3	6
Total		30	30	60

Households that receive the FBE have had electricity longer than those that have not. A third of the main breadwinners in both categories have 'some high school' and at least three main breadwinners of households that receive the FBE have a post matric qualification as well as two households who do not receive the FBE. The main breadwinners of a third of households that do not receive the FBE have matric, compared to only six households that receive the FBE. It seems then that the education levels of the main breadwinners in the sample are relatively high (matric or some high school).

Overall, meal preparation in the sample households falls to female members who take turns to cook. The majority of the women who are responsible for cooking also have relatively high education levels (matric or some high school).

The main language spoken by households in the survey is Sepedi (30%) and Setswana (20%), but Xitsonga, isiZulu, Sesotho, isiNdebele and SiSwati are also spoken.

6.3 The impact of the 100kWh FBE on meeting household needs for lighting, cooking, space and water heating, and powering appliances

6.3.1 Energy use for lighting

6.3.1.1 Energy use for lighting - Interviews

For lighting, Mrs. Zondi's household (no FBE) uses mainly electricity, but candles are used during load shedding or when they wish to save money on electricity, especially in the winter. Mrs. Mazibuko (No FBE) uses electricity, kerosene, and candles for her lighting needs. In an effort to cut back on electricity spending, she has resorted to using candles more often. She normally spends the same amount on candles in the winter as she does in the summer, namely R28 a month. The Mathebula's (No FBE) use electricity as their main source of lighting and use candles mostly during load shedding. Mr. Mathebula complains that vendors increase the price of candles in the winter. Candles cost them R12 in the summer and R15 in the winter.

For lighting, Mrs. Magolego (FBE) uses *only* electricity, but during load shedding, she uses candles and a kerosene lamp. She spends more on electricity for lighting in the winter than in the summer, but she does not diversify her energy use for lighting to save costs. Mr. Zuma's household (FBE) leaves the lights on "*for as long as the family wants*" in the summer, but in the winter, he is more mindful about saving electricity. For lighting, the Mosimane household (FBE) mainly make use of electricity but higher cost of living and loadshedding forced them to use more candles to meet their lighting needs. Mrs. Khoza's household (FBE) uses mostly electricity. Candles are mostly used during loadshedding but are also sometimes used to save electricity. All the participants that receive the FBE are satisfied with the ability of the FBE to assist them towards meeting their household's need for lighting. Figures 6.1 and 6.2 show typical devices that are used for lighting in Soshanguve.

Figure 6.1: Examples of a gas lamp and a typical candle holder

Figure 6.2: Console solar jars and a kerosene lamp

6.3.1.2 Energy use for lighting - Survey

The choice of energy for lighting is similar across both categories in the survey and show a similar pattern to that of the statistics for lighting in the 2012 DoE survey. As can be seen from Table 6.7, the use of electricity and candles are by far the most popular choice when it comes to choosing energy for lighting.

Table 6.7: Source of household lighting.

ENERGY FOR LIGHTING	E	FBE
Electricity	30	30
Candles	29	27
Kerosene	6	5
Solar energy	2	4
Gas	4	2
Other sources	1	0
Generator	0	0
Car batteries	0	0
Batteries	0	0

Please take note that no households in the survey use batteries, car batteries or a generator for their lighting needs. In fact, none of the households in this study make use of car batteries or a generator to meet any energy needs.

No great differences exist in the choice of energy fuels for lighting between the seasons. Most households in both categories do not use electricity as the sole source of energy, as they tend to diversify by using other energy sources such as candles. Thus, 74% of households in both categories diversify their energy for lighting. Only seven households in each category make use of electricity *only* for lighting in the summer. The same trend can also be seen for the winter.

No household makes use of candles *only*. Besides being used during loadshedding, candles are used by at least a quarter of households in both categories as a form of energy diversification to save electricity.

Kerosene and gas are also used as a back-up fuel in case of load-shedding. However, the use of kerosene and gas as a fuel to diversify energy use for lighting is not popular. This may be due to these sources being more expensive than candles. A few households diversify their energy sources by using electricity for half the time at night and then another fuel, mostly candles, gas or solar energy for the rest of the evening.

Overall, it seems that gas is a popular household fuel choice amongst households that do not receive the FBE. Gas is used for cooking, space heating and water heating. This is interesting and surprising, as gas is not a cheap commodity and these households have high income burdens. When one looks at the education level of the main breadwinner of these households though, one sees that they have matric or some high school. Later questions in the survey reveal that these respondents have a high awareness of the health dangers of 'dirty' fuels. It seems then that a few households in the survey who have a high-income burden and no assistance of the FBE are willing to pay the higher price for gas to use a 'cleaner' fuel.

When respondents were asked whether they have cut back on using energy for lighting in the past year, almost 84% of the households that do not receive the FBE answered in the affirmative compared to 70% of households that receive the FBE. In the same vein, only five FBE households gave a negative reply compared to nine households that do not receive the FBE. It can therefore be concluded that the FBE makes a positive contribution to meeting household's lighting needs. The reasons why households cut back on energy spend for

lighting is listed in Table 6.8. The same question was asked for all energy applications and the replies are similar across energy applications.

Table 6.8: Reason for lighting cut back		
REASON	E	FBE
The price of electricity has gone up	26	22
The price of groceries has gone up	17	17
The price of traveling has gone up	11	9
The price of kerosene has gone up	4	4
We had to cope with a financial emergency	4	4
We cut back in the winter	2	2
The price of gas has gone up	1	1

Although the question pertained to the use of all sources of energy used for lighting in general, most respondents indicated the rising price of electricity as their reason. When comparing the data of non FBE households with FBE households, a marginal difference can be detected except for the fact that more households that do not have the FBE list the rising price of electricity and the rising costs of travelling as a reason. The first can be taken as an indication of the effectiveness of the FBE to act as a 'buffer' for some households, but the second variance is interesting and will be discussed later in this chapter.

The second most mentioned reason in Table 6.8 is the steep increase in grocery prices. This is as a result of the drought in 2015 which negatively affected the farming sector and caused a rise in consumer prices for meat, dairy, and other basic food stuffs. More than half the respondents in both categories stated this issue as a reason for cutting back on energy spend for lighting and other energy applications.

As also can be seen from Table 6.8, besides the rising cost of travelling, other reasons were 'the need to pay school fees or pay medical bills', 'to cope with a financial emergency' and 'the rising price of kerosene'. Less important reasons were the need to cut back in the winter and the rising price of gas. It is important to mention that most households named a *combination* of reasons of which the most mentioned combination was the higher cost of electricity, groceries, and traveling. Please see Table 1 in Annexure C on page 234 for a comprehensive list of the combination of reasons for saving on lighting.

Respondents were asked what strategies they employ to cut back spending on energy for lighting. The most popular strategy for households that do not receive the FBE was “We go to bed early” (50%) whilst households that receive the FBE would rather “Switch off lights in rooms we don't use” (44%). Both strategies are employed in both categories, but households that do not receive the FBE have a bigger tendency to adopt the drastic measure of going to bed early. Other strategies include using more kerosene, using solar lights and – in the case of one household – making use of a rechargeable lamp. Note that households who do not receive the FBE make use of more diversified strategies for cutting back energy spend on lighting, while households that receive the FBE tend to use more kerosene.

Respondents were asked: “On a scale of 0 to 4, with 0 being very dissatisfied and 4 being very satisfied, how would you rate your satisfaction with access to electricity to meet your household’s need for lighting?” The ratings can be seen in Table 6.9.

Table 6.9: If you have electricity, on a scale of 0 to 4, with 0 being very dissatisfied and 4 being very satisfied, how would you rate your satisfaction with access to electricity to meet your households' need for lighting?

		Electricity	FBE	Total
	0	1	2	3
	1	5	6	11
	2	13	11	24
	3	7	8	15
	4	2	2	4
Total		28	29	57

As can be seen, the responses are spread evenly across categories and are generally quite positive as at least a third of responses in both categories gave high scores from 3 to 4. In fact, this question was asked for each household energy application and the satisfaction of receiving electricity to meet the need for lighting was the highest for any household energy need. This can be taken to be one of the most beneficial impacts of access to energy on household living standards. Table 6.10 shows the results of the ratings when they were added for each energy application. Note that satisfaction levels are the highest for lighting.

Table 6.10: Comparing the satisfaction levels of receiving access to electricity for meeting household energy needs amongst household categories									
LIGHTING		**COOKING**		**SPACE HEATING**		**WATER HEATING**		**APPLIANCES**	
NO FBE	FBE	NO FBE	FBE	NO FBE	FBE	NO FBE	FBE	NO FBE	FBE
60	60	47	47	24	24	46	44	49	59
0 pt. difference		0 pt. difference		0 pt. difference		2 pt. difference		10 pt. difference	

Respondents were also asked how they feel about the price they pay for electricity for lighting. Their replies are listed in Table 6.11.

Table 6.11: Affordability of electricity for lighting

		Electricity	FBE	Total
	Not affordable	6	4	10
	Affordable	24	22	46
	More than affordable	0	4	4
Total		30	30	60

As can be seen, most households stated that electricity for lighting is ‘affordable’. No non FBE household felt that electricity for lighting was ‘more than affordable’, whilst four households that receive the subsidy felt that is was. When taking into consideration as was pointed out in the first part of the chapter that at least a few households who do not receive the FBE has low energy burden, this can be taken as a positive indication of the benefit of the FBE.

Respondents that receive the FBE were also asked: “If you have the FBE, on a scale of 0 to 4, with 0 being very dissatisfied and 4 being very satisfied, how would you rate your satisfaction with the FBE to meet your household’s need for lighting?” Ratings can be seen in Table 6.12. As can be seen, only two households felt very dissatisfied and an overwhelming majority of respondents, namely 80%, experienced the FBE’s contribution for lighting as positive with eight households being ‘very satisfied’.

Table 6.12: If you have the FBE, on a scale of 0 to 4, with 0 being very dissatisfied and 4 being very satisfied, how would you rate your satisfaction with the FBE to meet your household's need for lighting?

		Electricity	FBE	Total
	Not applicable	30	0	30
	0	0	2	2
	1	0	4	4
	2	0	6	6
	3	0	10	10
	4	0	8	8
Total		30	30	60

On the whole, it seems that even though non FBE households are satisfied with access to electricity for lighting, the contribution of the FBE makes a very positive impact. When respondents were also asked at the end of the survey “How has access to the FBE benefitted your household?” half of the households that receive the FBE indicated that the FBE enabled them to “leave the lights on for longer”.

6.3.2 Energy use for cooking

6.3.2.1 Energy use for cooking - Interviews

(1) Mrs Zondi (No FBE)

Mrs Zondi’s household uses only electricity for cooking. They boil water with their electric kettle for tea. Supper consists of a traditional dish called ‘pap’ with an accompaniment of meat, such as chicken feet. There are two kinds of ‘pap’ consumed in South Africa, ‘soft porridge’ and ‘stiff porridge’. ‘Stiff porridge’ is a traditional porridge that is made from ground maize and is a staple food of most South Africans. When eaten for supper it is usually accompanied by meat and gravy. The latter consists of tomato relish which is cooked with oil and sugar. *Pap* is traditionally prepared on a wood fire (see Figure 6.3.)

Figure 6.3: South African 'pap' prepared over a wood fire and *pap* with gravy

Source: If I could, South African foodies

Mrs. Zondi cooks supper on a double hotplate (see Figure 6.5 on page 124). She will only cook this meal three times a week, as she makes enough *pap* to last for two days. The family relies on leftovers and pre-prepared meals to save on electricity. They do this twice a week, and for Sunday lunch. According to Mrs. Zondi, cooked meals can be purchased reasonably cheaply. Mrs. Zondi laments the fact that they cannot afford to cook traditional dishes more often. This is also due to the long cooking times of traditional dishes. These are dishes such as 'samp' with beans and 'mala mogodu', a dish made with tripe. Another favourite is pig's head, which also takes long to cook. 'Samp' is a crushed maize dish, usually accompanied by beans and is a staple dish of many (see Figure 6.4).

Figure 6.4: Traditional African carbohydrate-based dishes dumplings, 'vetkoek', and 'samp' with beans

Source: *A Hungry African, Pick and Pay*

Figure 6.5: A typical stove top kettle used for boiling water over fire, gas, kerosene or coal and a double hotplate and electric kettle

The Zondi's household buys kerosene in twenty litre drums which costs them roughly R200 a month. (See Figure 6.6)

Figure 6.6: Example of a kerosene stove and a twenty-litre kerosene drum

(2) Mrs. Mazibuko (No FBE)

Mrs. Mazibuko uses electricity and kerosene to prepare meals. Breakfast usually consists of a brown porridge called 'Maltabella', which is prepared with boiling water. She sometimes

uses her electric kettle for this, but she also uses her non-electric kettle on her kerosene stove at other times to save electricity. The kerosene stove is used indoors. For lunch, she prepares *pap* and spinach. When she makes *pap,* she makes enough to eat for supper or for the next day. Consequently, she uses electricity on Mondays, Wednesdays and Fridays and then use the kerosene stove on alternate days.

For supper, Mrs. Mazibuko will often eat leftover *pap* from lunch with the addition of meat – such as chicken livers prepared on the double hotplate. She uses her double hotplate about three times a week to prepare supper, the kerosene stove twice and she does not boil the electric kettle but uses the kerosene stove to boil water for supper. According to Mrs. Mazibuko, she diversifies her energy use in this way to save time, food, and electricity. She only buys a cooked meal once a month as a treat to save time in preparing a meal as well as to save energy.

Mrs. Mazibuko would like to be able to use a microwave and a deep fryer but is not able to as these appliances are expensive, and she knows that she will not be able to afford the electricity they use anyway. She will also prefer to be able to use her electric kettle more but cannot because of its high energy requirement. She can also not afford to prepare her favourite dish, pig's head, which takes a long time to cook.

(3) Mrs. Mathebula

The Mathebula household uses electricity and firewood for meal preparation. They make fire outdoors and do not use a shelter like some of their neighbours do. Breakfast usually consist of bread with butter and jam (fruit jelly preserve), or soft porridge, and a cup of tea. Consequently, the kettle is the primary use of electricity in the mornings. For lunch, the household eat dumplings (see Figure 6.4) which Mrs. Mathebula prepares in bulk over the weekend. The dumplings are reheated on the double hotplate. African dumplings are a traditional type of cake, which is prepared with flour and water and cooked in oil. They have tea with their lunch.

For supper, the household consumes *pap*, with the addition of meat, such as chicken, and a vegetable such as cabbage. They use their double hotplate to prepare the meat but use the fire outside to prepare the *pap.* They do not cook *pap* every day for supper though.

Instead, like the Zondis and Mrs. Mazibuko, they rely on eating leftovers. In this way, *pap* is also sometimes drunk for breakfast or lunch in a drink called ‘mageu’, which is fermented *pap* made with sugar and banana. Like the others, the reason this household prepares food in bulk is to save energy. They also buy cooked meals once or twice a week to save energy.

According to Mr. Mathebula, their family would strongly prefer to be able to use other cooking appliances such as an oven, toaster, or a microwave/oven combination. Unfortunately, these appliances have a high rate of energy consumption. They would also like to be able to cook some traditional dishes like the *mala mogodu*, but cannot, as its cooking time is long, and it uses too much energy.

(4) Mrs. Mkhize (No FBE)

As already explained Mrs. Mkhize has been left in a dire financial situation upon her husband’s passing. To make ends meet she has had to generate an income. She decided to open a crèche at her house. The problem she now experiences is that the parents of her charges expect their children to eat cooked meals for breakfasts and lunch. This means that she is forced to use her stove to prepare soft porridge for breakfast and to cook *pap* and meat for lunch. This has increased her electricity bill considerably as she now falls into a higher electricity-spending category according to the IBT. As a result, she has had to resort to prepare lunch over a wood fire in an outdoor shelter.

(5) Mrs Magolego (FBE)

Mrs. Magolego uses electricity and kerosene for cooking. She uses an electric kettle and a microwave. Breakfast usually consists of bread with peanut butter and a cup of tea. She says that, despite the FBE, she still cannot afford the use of appliances other than the kettle and microwave for preparing breakfast. Lunch also consists of bread with jam and juice, but she says the FBE has enabled her to use some cooking appliances like her double hotplate to prepare cooked meals for lunch some days. For supper, Mrs. Magolego prepares *pap* with cabbage and tinned fish. Like many of the other participants, Mrs. Magolego makes enough for there to be leftovers. The *pap* is reheated in the microwave as needed. She uses the electric kettle for preparing the *pap* and take turns during the week to either use the double hotplate (three times a week) or the kerosene stove (twice) to cook the *pap*.

She says that the FBE has enabled her to use her double hotplate and microwave more, which she could not afford to use before. It also enabled her to cook some meals with lengthy cooking times such as lentils and beans. Nevertheless, the subsidy has not enabled her to stop using her kerosene stove, and during load shedding, she is also forced to cook with firewood to save on kerosene.

Mrs. Magolego buys cooked meals twice a week for herself and her daughter. This saves her time and electricity costs. She would like to use the mini-oven appliance and a slow cooker in the future, but she cannot afford to use it now. She says that she would prefer to cook dishes like *samp* with beans more, but she cannot afford to cook it as much now.

(6) Mr. Zuma (FBE)

The 100kWh FBE does not cover Mr. Zuma's large household's needs for cooking. The family diversifies their cooking energy by using electricity, firewood, and kerosene. For breakfast, the family eats buttered brown bread with jam or peanut butter and boils water for tea. Sometimes they make gravy in a cast iron pot on a fire in their outdoor shelter. The shelter is a corrugated iron structure which is open on one side and is used quite widely in Soshanguve for cooking food and heating water with 'dirty fuels' such as kerosene and firewood as there is an awareness that burning these fuels indoors carries health risks. The shelter makes it possible for families to cook food and heat water no matter the weather (see Figure 6.7 on next page). The firewood is bought from local sellers that cut wood in the adjacent rural area. A load of firewood for a week costs the household R75.

Mr. Zuma's household consumes bread with juice or tea for lunch on most days. Mr. Zuma himself sometimes eats lunch at a restaurant close to his workplace. The food is affordable at roughly R35 per dish (2016). According to Mr. Zuma, the big difference between living in a rural area (where he comes from) and living in the city is that, in rural areas, one has to cook for oneself; while in the city one can buy reasonably priced food.

For supper, Mr. Zuma's partner prepares *pap* with meat such as chicken and vegetables such as cabbage. They diversify their energy use for preparing supper by using electricity, firewood, and kerosene. They use their double hotplate only three times a week to prepare a meal. Mr. Zuma complains that one meal for his household of seven uses about 12kWh

of electricity when prepared with the double hotplate. This means that they resort to using this appliance sparingly as they want their 100kWh of free electricity to last as long as possible. For the rest of the week, his partner cooks supper in a cast iron pot over a fire in the outdoor shelter (see Figure 6.7). The family got rid of their kerosene stove when they received electricity in 1999, but Mr. Zuma had to buy one again in 2016 to diversify their energy sources. This was because of the higher cost of living in general and the need to save electricity. They do not like the taste of food prepared with kerosene though, so they prefer to use it to boil water instead of using their electric kettle and they also use it to prepare small parts of a meal. They buy the kerosene in bulk in twenty litre drum units (see Figure 6.6).

The FBE does not enable the Zuma household to use a deep fryer, an electric frying pan, and a toaster as they would like. Mr. Zuma indicated that they would also like to be able to afford to cook more traditional dishes such as 'mopani worms' but cannot afford it now. He does mention that the FBE has made it possible for them to be able to afford to cook some traditional dishes more, like *samp*, beans, and 'marapo'. Mr. Zuma is satisfied with the FBE's contribution in meeting his family's cooking needs as it has assisted them to afford to do some cooking with an electric appliance.

Figure 6.7: Mr. Zuma's wood stored next to his outdoor shelter and the family's cast iron pots for heating water and cooking food in the shelter.

(7) Mrs. Mosimane

Mrs. Mosimane is responsible for cooking all the meals for her household. However, as she often works night shifts, food preparation is influenced by her working hours. For example, the household receives a hearty breakfast of eggs, chips, bread, and tea, if she is not working in the morning. She uses her kerosene stove to prepare this breakfast. She would prefer to use her fourplate stove for this, but the electricity consumption is too high and the contribution of the FBE is not enough. This is also the case with the kettle. She usually uses her kerosene stove to boil water for tea but when she is working the day shift she is usually in a hurry and uses the electric kettle to save time.

When Mrs Mosimane is not working during the day she cooks fried eggs on either her fourplate stove, electric frying pan or kerosene stove. This is eaten with bread and 'atchar;' and a cold drink. 'Atchar' is a cold pickled spicy sauce of Indian origin that is popular in South Africa. Mrs. Mosimane says that the FBE has enabled her to use her fourplate stove sometimes to prepare lunch. The family also sometimes buy meals for lunch when she is working day shifts. In the evenings the household eats *pap* accompanied by meat such as 'wors'. South African 'boerewors' is a sausage made with ground beef, pork, lamb, and pork fat and is popular in South Africa. Mrs. Mosimane uses the electric kettle to boil water to prepare the *pap* but alternates between using her fourplate stove and her kerosene stove to cook the *pap* and the meat. The electric kettle is also used to boil water to prepare beverages in the evening. On her days off, Mrs. Mosimane cooks in bulk and freezes most of it for her household to eat when she is working evening shifts.

Mrs. Mosimane laments the fact that she cannot use her fourplate stove and her electric frying pan more often. She heavily relies on kerosene. She would prefer to be able to use a toaster and a pressure cooker but cannot afford the electricity it uses. She says the FBE has enabled her to use a fourplate stove and a frying pan sometimes. It has also enabled her to prepare some traditional dishes occasionally such as 'pork leg' with *samp* and beans more often, but she would prefer to be able to afford to cook these meals more regularly. The Mosimane household seldom cuts back on their energy spend on cooking. This is probably as a result of the fact that their cooking is done mostly with kerosene which is cheap. Their use of electricity for cooking is already minimal. Note that Mrs. Mosimane does not make use of firewood to prepare meals.

(8) Mrs. Khoza (FBE)

Mrs. Khoza and her daughters take turns to cook. The family usually eats ‘soft porridge’ or bread for breakfast with a cup of tea. The household alternates between using their electric kettle or the non-electric kettle over the kerosene stove. They sometimes use their toaster at breakfast. For lunch the household typically eats *pap* with an accompaniment of meat such as chicken feet and fruit juice. Mrs. Khoza boils the kettle twice in the mornings: once for tea and once for the *pap*. Either the double hotplate or the kerosene stove is used to prepare the *pap* and chicken feet. She can only afford to use the double hotplate three times a week, so she also makes enough *pap* with it so that it can be saved for later.

For supper, the family eat *pap* again with ‘inkomazi’ (sour milk) and meat such as chicken. They sometimes use their double plate to cook the *pap* for supper instead of lunch. They can only afford to use it three times a week, however, so the preparation of *pap* is a matter of convenience. Mrs. Khoza says that they seldom buy pre-cooked meals as they cannot afford it. They use kerosene when they run short on electricity or, to diversify their energy use during the month. Cooking in bulk and eating leftovers is therefore their main strategy for managing their electricity use for cooking. They try to make their FBE last for the whole month.

Mrs. Khoza would prefer to be able to use her toaster more and use a pressure cooker and a fourplate stove, but it uses too much electricity. Like most of the other participants, Mrs. Khoza would also love to cook *samp* and beans and pig’s head more often. Yet again, lengthy cooking times renders these dishes unviable Mrs. Khoza says that the FBE has enabled her to cook ‘mielie rice’ more often. This is maize that has been finely cut so that it resembles rice. *Mielie* rice has a short cooking time. Although the household cannot use electricity much for cooking, Mrs. Khoza is more than happy with the contribution that the FBE has made in meeting her family’s need for cooking.

6.3.2.1 Energy use for cooking - Survey

(1) Introduction

Having access to electricity has given households the opportunity to use electric appliances to prepare meals. For many households though, cooking remains a time- and energy-intensive undertaking that those in the Low LSM category struggle to cope with. Although each of the study households use some electric appliances to prepare meals, 74% of households in *both* categories still make use of a kerosene stove.

Note that the survey included data about a cooking device called the 'wonderbag'. This is a cotton bag that has heat retaining and insulating properties. A South African entrepreneur designed it in 2008 during the beginning of the South African electricity crisis when households were forced to cope with load-shedding. This entrepreneur was an ordinary homemaker who wanted to find a way in which she could save energy on cooking. It works as follows: A pot of food is first brought to the boil on a cooking device and is then placed inside the 'wonderbag'. A lid is placed on top and it is securely tied to insulate the contents. The food is then left to simmer until cooked. This device saves a considerable amount of cooking energy, especially for dishes with lengthy cooking times. A 'wonderbag' retails for between R150 and R350 (2017). There is also an opportunity for the public to buy a 'wonderbag' for R150, which is then donated to a household that cannot afford it. Figure 6.8 shows an image of a 'wonderbag'.

Figure 6.8: The 'wonderbag'

Source: Yuppiechef, Donate-a-Wonderbag

To analyse the contribution of the 100kWh FBE in meeting household cooking needs, it is necessary to answer two questions: firstly, to what extent has access to the FBE allowed households to use electric cooking appliances, and secondly, how has it affected the use of other fuels?

(2) The use of electric cooking appliances

Satisfying the need for food preparation is arguably the largest contribution that access to electricity has provided. When examining the impact of the FBE on the use of the electric kettle, for example (see Table 2 in Annexure C on page 234), one sees that the FBE had the ability to assist at least *a* third of its beneficiaries to either make use of the electric kettle for the first time, or to make use of it more often. Note though, that more than half of households reported that they use their kettle in the same way as before. When looking at the data one must remember that the choice people make with regards to how they use their kitchen appliances depend on their priorities. The main objective of households who receive the FBE is to make their FBE last as long as possible. Household members monitor their pre-paid electricity meters carefully and make decisions to prioritise necessary appliances in an effort to manage this (focus group discussion).

Due to the kettle's high energy consumption, many households choose to save electricity by boiling water with an alternative energy source, such as a kerosene or gas stove. The same is true for other cooking appliances. The double hotplate is the entry cooking appliance for people who receive electricity as it is the cheapest. Most households in the LSM one to three category have to save up to be able to purchase a standard fourplate electric stove. The double hotplate therefore has a low status and is not high on their cooking appliance wish list. Table 6.13 shows the wish lists for cooking appliances for both categories. This was in response to the question "What food preparation appliances can you not use or afford now that you would like to use in the future to prepare meals?"

Table 6.13: Cooking appliance wish list		
APPLIANCE	**E**	**FBE**
Fourplate electric stove	19	10
Electric frying pan	14	15
Deep Fryer	10	14
Microwave	10	11
Gas stove	10	10
Pressure cooker	9	9
Toaster	10	8
Slow cooker	10	4
Air fryer	5	5
Microwave-oven combination	3	4
Double hotplate	2	1

Based on the data in Table 6.13, the fourplate electric stove is the most desirable and the double hotplate the least desirable appliance. Nevertheless, when one looks at how the FBE has changed the use of the double hotplate (see Table 3 in Annexure C on page 235), we see that seven households who was not able to afford to use a double hotplate before they received the FBE could now afford to use it, three households indicated that they can make use of their double hotplate *more* and one household indicated that the FBE enabled them to replace their double hotplate with using a four plate electric stove.

When respondents were asked “If you have the FBE, are there any appliances that you could not afford to use before you received the FBE that you can afford to use now?” Eight respondents selected the fourplate stove (see Table 5 on page 235 in Annexure C). When one compares this list with Table 6.13, we see that a possible reason why fewer households that receive the FBE have indicated this appliance as a wish list appliance is because the FBE has already enabled at least a few households to use it. Please see Table 4 in Annexure C on page 235 for a comprehensive account of how households that received the FBE can now use the fourplate stove.

(3) The use of non-electric cooking devices and energy fuels

To appreciate the way in which the FBE has contributed towards the living standards of households, it is necessary to look at the way in which the FBE has enabled households to move away from using ‘dirty’ fuels for cooking. This was also one of the stated objectives of the initiative. However, before ‘dirty’ fuels are discussed, it would be helpful to examine how the FBE has influenced the ability of households to use gas, which can be considered a ‘neutral’ fuel, and ‘green’ technology, namely solar technology and the ‘wonderbag’.

The use of gas for cooking is mostly employed by non FBE households. The small number of households that use gas for cooking, utilise it to diversify their energy sources and to guard against loadshedding. These households have indicated that they use gas because it is a more convenient, available, affordable, and healthier fuel to use than electricity (see Table 6 in Annexure C on page 236). Only a few households in the sample make use of a ‘wonderbag’ and the FBE did not make a significant impact in the way people use this device. Only one household that receive the FBE indicated that they used some form of solar energy for cooking before they received the FBE but stopped using it upon receiving the subsidy. It is not clear if it was a SHS or a solar cooker. As they indicated that they used it ‘a few times a day’, it suggests that it must have been a SHS, as solar cookers sold locally do not have energy storage capacity.

Concerning the use of ‘dirty fuels’: the food preparation device that is the most concerning to households is the non-electric kettle used in conjunction with either kerosene, wood, coal, or charcoal. Table 7 in Annexure C on page 236 indicates the way in which the FBE has influenced non-electric kettle use by households that receive the subsidy. At first glance it might seem that many positive changes took place in the use of this device upon reception of the FBE, but almost a third of households that receive the FBE still continue to make use of a non-electric kettle. This is an improvement of only 15%.

The kerosene stove is the least favoured appliance in Soshanguve. Respondents dislike the taste of food prepared with kerosene. They are also concerned about the health effects and dislike the smell it leaves. This is the fuel that respondents want to phase out as soon as possible (focus group discussion). Nevertheless, more than three-quarters of households in both categories still make use of it. Two-thirds of FBE respondents can use this appliance

less or have been motivated to use it outside their dwelling. Table 8 in Annexure C on page 237 shows the impact of the FBE on the use of the kerosene stove. It seems that the 100kWh FBE made it possible for some households to use the kerosene stove less. Worryingly, three respondents reported that they did not use a kerosene stove before they received the FBE and that they have acquired one since. It seems that some households experienced situations of vulnerability which induced them to move 'down the energy ladder'. This can also be seen in the case study of Mr. Zuma.

The use of firewood for cooking, if it is used as the main source of cooking energy, is a major indicator of energy poverty. In the sample, more than half of households in each category use a cast iron pot over a wood fire to prepare meals. The use of firewood is therefore popular, but not as popular as kerosene. Most households (70%) that use this food preparation method, reside in Soshanguve North. Only nine households in Soshanguve South use firewood to prepare meals. As was seen from the qualitative part of the study that was done in Soshanguve North, this area has ready access to cheap wood fuels from the adjacent rural areas. This data is therefore not surprising. Nevertheless, even though more than half of sample households use cast iron pots over a wood fire, it is not used as a daily survival strategy but rather as a sporadic energy diversification tool or as a backup during loadshedding. Only three of the non FBE households use it as a strategy to prepare food more than once a day. Fewer non FBE households use firewood than FBE households. Table 9 in Annexure C on page 238 gives an indication of how the FBE has changed the way households use wood for cooking. As can be seen, two households stopped using firewood completely, one household moved their use of it to an outdoor shack, six households now only use it during loadshedding and, two households started using it less. Note that seven households continue to use firewood in the same way and that two households who did not use firewood before, started to use it after they received the FBE. The result for firewood is therefore quite mixed.

The use of other 'dirty fuels' is minimal. One non FBE household uses a coal imbaula outside for cooking and one FBE household an imbaula inside the house for cooking. No household makes use of cooking with charcoal indoors, but one non FBE household uses charcoal outdoors on Christmas day for entertainment. The respondent from this household indicated that he sees the use of charcoal as a status symbol. This a probably due to the fact that

charcoal is expensive and is used mostly by middle class South Africans. This view of charcoal is quite ironic when compared to its use in the rest of Sub-Saharan Africa.

(4) Other benefits of the FBE to meet households cooking needs.

The respondents were asked: “Are there any dishes that you would like to cook more but cannot because it uses too much energy to make?” In response, 77% of households that receive the subsidy replied in the affirmative, compared to 94% of households that do not receive the subsidy. Table 6.14 shows the responses of households that receive the FBE.

Table 6.14: If you receive the FBE; are there any dishes that you could not cook before that you can cook now because you can afford it with the FBE?

		FBE
	Yes, all the time	1
	Yes, quite a lot	3
	Yes, but only sometimes	19
	No	7
	Not applicable	0
Total		30

The FBE has thus enabled at least two-thirds of households to cook dishes that they could not cook before. As with lighting, households were asked whether they had to resort to cutting back on their energy spending for cooking over the year (see Table 6.15.).

Table 6.15: In the last year, has your household cut back spending on energy for cooking?

		Electricity	FBE	
	Never	2	1	3
	Rarely	4	1	5
	Occasionally	9	7	16
	Often	13	15	28
	Very often	2	6	8
Total		30	30	60

More FBE households gave negative answers than non FBE households. This is an anomaly. When this finding is cross tabulated with that of household income burden there

is no correlation either. In the focus group discussion this phenomenon was debated, but the field assistants was also puzzled by this anomaly.

The reasons for cutting back appears to be similar to responses for lighting (see Table 6.16). Be that as it may, more respondents named rising electricity, grocery, and kerosene prices as the reason for their household taking money-saving measures.

Table 6.16: What is the reason why you have cut back spending on energy for cooking?		
REASON	E	FBE
The price of electricity has gone up	23	28
The price of groceries has gone up	19	25
The price of traveling has gone up	11	9
The price of kerosene has gone up	5	13
We had to cope with a financial emergency	7	4
The price of gas has gone up	2	1
We cut back in the winter	1	0

Respondents were also asked: “What strategy/strategies do you use to cut back spending on energy for cooking?” Table 10 in Annexure C on page 238 shows a comprehensive list of combination of strategies but Table 6.17 shows the strategies in order of popularity.

Table 6.17: Strategies to save spending on energy for cooking		
STRATEGY	**E**	**FBE**
We eat leftovers	21	21
We use less electricity for cooking	17	18
We prepare food in bulk	12	13
We eat more food that does not need to be cooked	8	10
We use more kerosene for cooking	7	8
We use more firewood for cooking	6	7
We buy cooked meals occasionally	4	5
We use less gas for cooking	4	4
We use less kerosene for cooking	1	6
We use a 'wonderbag'	4	2
We use more gas for cooking	3	2
Other	1	1

As Table 6.17 shows, the most popular strategy in both categories is making enough food when using energy to allow for storage and consumption later (focus group discussion). In this way, households only use their double hotplate, fourplate electric stove or other cooking device once a week or less. They therefore save a considerable amount of time and energy on cooking. Other popular strategies are ‘to use less electricity for cooking’ and ‘to eat more food that does not need to be cooked’. This also corresponds with the findings in the qualitative part of the study.

Diversification of fuels used for cooking is also cited as an important strategy. Note again how the use of certain fuels ‘more’, or ‘less’, indicate the uniqueness of households’ ECHDE. It is also interesting to note that households that receive the FBE have a tendency ‘to use less kerosene for cooking’. This seems to indicate that the amount of kerosene they use for cooking is already prohibitive. They seem to make up for the decreased use in kerosene by increasing the use of firewood, which is a cheaper option. Using more gas is also a strategy employed by some households, but again, some households use it less and use a cheaper fuel instead. Overall it seems that rising electricity prices and higher costs of living have forced households in both categories to move ‘down the energy ladder’ by firstly using less electricity for cooking, secondly, making use of either more kerosene or gas and, thirdly, when even kerosene or gas becomes too expensive, to use more firewood.

Respondents were asked how they feel about the price they pay for electricity for cooking. Their responses are listed in Table 6.18.

Table 6.18: How do you feel about the price you pay for electricity for cooking?

		Electricity	FBE	Total
	It is not affordable	28	23	51
	It is affordable	2	7	9
Total		30	30	60

As can be seen, most respondents felt that the price of electricity was ‘not affordable’. However, five more FBE households feel that the price for energy for cooking ‘is affordable’ which is positive. The respondents were asked to rate their satisfaction with access to electricity to meet their needs for cooking (see Table 6.19).

Table 6.19: On a scale of 0 to 4, with 0 being very dissatisfied and 4 being very satisfied, how would you rate your satisfaction with receiving electricity to meet your household's need for cooking?				
		Electricity	FBE	Total
	Not applicable	0	1	1
	0	2	3	5
	1	13	10	23
	2	12	12	24
	3	2	3	5
	4	1	1	2
Total		30	30	60

Responses were similar across categories and are fairly neutral. This suggests that access to electricity alone does not fulfil the need for cooking energy. When FBE respondents were asked to rate their satisfaction with the subsidy with regards to their cooking needs, most responded favourably, while only three respondents voiced dissatisfaction. Almost half of the beneficiaries of the FBE gave a satisfactory “3” in response and two households seem ‘very satisfied’. Their responses can be seen in Table 6.20.

Table 6.20: If you have the FBE, on a scale of 0 to 4, with 0 being very dissatisfied and 4 being very satisfied, how would you rate your satisfaction with receiving the FBE to meet your household's need for cooking?				
		Electricity	FBE	Total
	Not applicable	30	0	30
	0	0	1	1
	1	0	3	3
	2	0	10	10
	3	0	14	14
	4	0	2	2
Total		30	30	60

This is an interesting anomaly, as it seems that, despite the fact that the contribution of the FBE has not allowed households to abandon ‘dirty fuels’, enabled them to cook certain dishes as much as they would like to, and only allowed a few households to make use of ‘higher status’ appliances than before, most respondents were quite satisfied with the contribution of the FBE to meet their cooking needs. This correlates with the interview findings.

6.3.3 Energy use for space heating

6.3.3.1 Energy use for space heating - Interviews

The Zondi household (No FBE) use a gas heater in winter. This costs them approximately R350 a month. Mrs. Mazibuko (No FBE) uses a kerosene heater sparingly on cold days. She will run the heater for roughly four hours a day in winter – costing her approximately R10 a day. The Mathebula household (No FBE) also uses a kerosene heater. Mr. Mathebula finds that a kerosene heater is inexpensive as it only costs him R190 a month. Mrs. Magolego (FBE) says she cannot afford to use electricity in the winter to heat her house. She also uses a kerosene heater, which, like her neighbour, Mr Mathebula, costs her R190 a month.

The 100kWh FBE does not fulfil Mr. Zuma's large household's need for space heating. When they used to live in their shack, they used a coal *imbaula* to heat their living spaces, but they stopped using it when the supply of coal ran out in their area. A tractor filled with coal used to supply their street but it stopped coming. Mr. Zuma then tried to purchase coal from the coal yard in Block P in Soshanguve, but the depot ran out of coal as well. They now prefer to keep warm by using clothing and blankets and by going to bed early in winter. However, on extremely cold days, they resort to making fire indoors.

The Mosimane household (FBE) sometimes use their electric heater in winter for short periods. The rest of the time they use their kerosene heater to save money. Mrs. Mosimane finds the use of electricity for space heating completely unaffordable. She states that the FBE has only enabled them to afford to use the electric heater on rare occasions. The Khoza household use either their electric heater or a kerosene heater in winter. They use their electric heater sparingly. Like the Mosimanes, they make use of their kerosene heater more often.

6.3.3.2 Energy use for space heating - Survey

Only 50% of households in both categories make use of some form of energy to heat their spaces in the winter. This correlates with national statistics on fuel use for space heating as seen in Chapter 3. The use of 'dirty fuels' such as kerosene, firewood, and coal for heating

is dangerous and unhealthy. Table 11 in Annexure C on page 240 shows the combination of energy used for space heating in both categories. Table 6.21 shows the popularity of the fuels across categories.

Table 6.21: Energy use for space heating		
ENERGY USE	**E**	**FBE**
Kerosene	5	9
Electricity	8	5
Firewood	3	5
Gas	4	1
Coal	3	0

More FBE households use kerosene and firewood for heating than households that do not receive the subsidy and slightly more non FBE households use electricity than FBE households. Interestingly enough, the two non FBE households with a low poverty burden prefer not to use any energy for heating. On the other hand, the non FBE households that uses energy for space heating all have a high-income burden of between R200 to R600 per household member. This again shows how diverse household priorities are when it comes to energy needs.

Similar to national statistics, 70% of the households in this sample prefer to use a single fuel type for heating. Non FBE households, however, use coal and gas for heating, whilst FBE households prefer to use a combination of electricity, kerosene, and/or firewood.

To understand the severity of the problem of using ‘dirty fuels’ in this study, one must understand how often these fuels are used for heating. Table 12 in Annexure C on page 240 illustrates the combination and frequency of energy sources and uses for heating. ‘Whenever we are cold’ can be taken to mean that the fuel is used frequently. In examining electricity use, it becomes apparent that, even though slightly more non FBE households use electricity for heating, it is possible to conclude that both categories use the same amount of electricity for heating. Non FBE households use electricity sparingly while FBE households use it for longer intervals.

Concerning the use of other energy sources, more FBE households use kerosene than non FBE households. As seen in the qualitative part of the study, heating homes with kerosene

heaters is cheap, costing roughly R190 a month. Households that receive the FBE also tend to use more firewood. Non FBE households tend to use more gas and coal than kerosene and firewood. This is an interesting anomaly as using gas is more expensive than the latter. As already mentioned though, most households who do not receive the FBE and use gas, have high education levels.

The fact that only five FBE households make use of electricity for heating shows that the FBE does not adequately cover household heating requirements. Again, it comes down to a household's energy priorities. This is reflected in the answers to the question: 'How did the introduction of the FBE change your energy use for space heating?' (see Table 13 in Annexure C on page 241). A few households indicated that they stopped using a 'dirty fuel' when they received the FBE, or that they used it less. From Table 13 it is also clear that some households that receive the FBE were able to 'move up the energy ladder' when receiving the FBE by either being able to use more kerosene instead of relying on coal or firewood or using electricity instead of a 'dirty' fuel. This shows an improvement of 18% in the use of less 'dirty fuels' for space heating. Respondents were also asked how they feel about the affordability of electricity for space heating. Their answers are given in Table 6.22.

Table 6.22: Affordability of electricity for space heating

		Electricity	FBE	Total
	Not applicable	1	2	3
	It is not affordable	26	27	53
	It is affordable	3	1	4
Total		30	30	60

As can be seen, most households in both categories reported that electricity use for space heating was 'not affordable'. In the same vein, respondents recorded very low satisfaction levels when asked to rate their satisfaction with receiving electricity to meet their need for space heating (See Table 6.23).

Table 6.23: If you have electricity, on a scale of 0 to 4, with 0 being very dissatisfied and 4 being very satisfied, how would you rate your satisfaction with receiving electricity to meet your household's need for space heating?				
		Electricity	FBE	Total
	0	14	16	30
	1	10	8	18
	2	4	1	5
	3	2	3	5
	4	0	1	1
Total		30	29	59

Only four FBE households compared to two non FBE households gave a positive rating. When FBE households were asked to rate their satisfaction with receiving the subsidy to heat their spaces, their replies were also mostly negative. Table 6.24 show their responses.

Table 6.24: If you have the FBE, on a scale of 0 to 4, with 0 being very dissatisfied and 4 being very satisfied, how would you rate your satisfaction with receiving the FBE to meet your household's need for space heating?				
		Electricity	FBE	Total
	Not applicable	30	0	30
	0	0	13	13
	1	0	9	9
	2	0	5	5
	3	0	2	2
	4	0	1	1
Total		30	30	60

It must be noted that at least three households were quite satisfied. Some households see the use of electricity as a luxury that they cannot forgo. For at least three households then, the subsidy afforded them the opportunity to use electricity in the winter for heating, which they obviously see as a priority.

6.3.4 Energy use for water heating

6.3.4.1 Energy use for water heating - Interviews

All participants in the study leave water outside in the warm summer months so that they can bath in tepid water at night. This helps them save money. In the winter, they have no choice but to use some form of energy to heat their water.

In the Zondi household (No FBE), water heating for washing is prepared by boiling their electric kettle and mixing it with tap water to enable them to wash dishes and laundry. If they want to heat larger quantities to take a bath, they heat water in a larger container over a wood fire in an outdoor shelter. They receive their wood supply from the local sellers who cut wood in the adjacent rural area. As already mentioned a single bunch of firewood costs R75 and is the cheapest form of energy in Soshanguve North.

For washing, Mrs. Mazibuko (No FBE) alternates between boiling water in her electric kettle, on the kerosene stove, or in a cast iron pot on an outdoor fire. She prefers the electric kettle as it boils quickly, but other methods are cheaper. She also prefers to use kerosene in the winter and firewood in the summer for water heating. The reason for this is that it is too cold to go outside in the winter to tend to a fire. Using the kerosene heater to warm water indoors in winter is more convenient and provides warmth to the house. Figure 6.9 shows examples of water heated with wood and gas.

Figure 6.9: Examples of water heated over a fire in a shelter and water heated over a gas cylinder

The Mathebula household (No FBE) prefers to heat water with gas as it heats quickly. Unfortunately, gas is expensive and Mr. Mathebula feels that they spend too much on it for heating water. They spend the same amount on gas in summer and winter even though they use the sun in the summer for heating water. They spend approximately R300 on gas a month. Mr. Mathebula also sometimes buys firewood to save money, but he feels wood takes too long to heat water. As they rely on the sun to heat their water in summer they use less firewood in summer than in winter. As a result, they spend only R75 on firewood (one load) in summer, and R150 (two loads) in winter.

Mrs. Magolego (FBE) also uses a combination of the sun and firewood in summer for water heating, and kerosene in winter as it has the added benefit of heating the house. Mrs. Magolego does not use electricity to heat water and feels that the FBE has not made a big difference in helping her meet her energy needs in this regard.

The Zuma household (FBE) use electricity and firewood to heat water for washing and bathing. In the past, they used to boil the kettle in the summer to add to the already tepid water that stood in the sun during the day. Mr. Zuma found this use of their electricity costly as it ate into their FBE; consequently, they stopped using electricity and replaced it with using firewood in the outdoor shelter. See Figure 6.9 on the previous page for the container Mr. Zuma uses for this purpose. Even the use of wood for water heating became too expensive for Mr. Zuma. After the interview, Mr Zuma purchased a kerosene stove to diversify their energy use for cooking and water heating. The case of Mr. Zuma is interesting, as it shows how even an interview with an outsider can cause a respondent to reflect on their energy use and change their HDE.

In the summer, the Mosimane household (FBE) heat water in a container outside in the sun and sometimes use their kettle or kerosene stove to boil water. Because the water does not have to be boiling to be comfortable to bath in, they do not use a lot of energy to prepare water for this purpose. In winter, however, they use more kerosene and electricity to boil water. This drives up their costs. Mrs. Mosimane believes the FBE only assists them slightly to meet their water heating needs in winter. The Khoza household (FBE) use their electric kettle to prepare water for washing dishes and bathing. Left over water from the kettle is used for washing dishes or is added to the bath water. In the summer, they do not heat water as they bathe in cold water. The household boils the kettle often for bathing in the winter.

Mrs. Khoza believes that this uses too much electricity and makes it more difficult for her to make the FBE last longer.

6.3.4.2 Energy use for water heating - Survey

In the survey, all non FBE households but one, heat water for washing or bathing in the summer. There is a difference in the way each household uses energy for water heating in summer and winter. Similar to the interview participants, many households use the sun as a source of energy in the summer. Table 6.25 shows energy use for heating in the summer.

Table 6.25: Energy use for heating water in the summer

ENERGY USE	E	FBE
Electricity (electric kettle)	26	25
Kerosene	12	19
Heat water outside in the sun	12	16
Firewood	8	14
Gas	5	1
Solar geyser	1	3
Coal	0	1
Electric geyser	0	0

Households from both categories use a wide range of fuels and strategies to heat water in the summer. See Table 14 in Annexure C on page 241 for a comprehensive account of the combination of fuels used in the summer. Only a few households in the survey had geysers. Those that had geysers though, did not use it, as it is too expensive to use.

Most households prefer to use an electric kettle for washing or bathing. It is again noticeable how more FBE households use kerosene and firewood than non FBE households. At the same time, non FBE households use more gas. Many households in both categories use the strategy of leaving water outside in the sun to heat. Some households have been fortunate enough to be recipients of the governments SHS programme and use solar geysers, but they are in the minority.

The ability of households to save electricity through heating water in the sun is an advantage of summer. In the winter though, there is a greater need to bath in hot water. Consequently,

households face a challenge to manage their energy use in the winter. FBE households also find it difficult to decide which needs to prioritise lest they exhaust their monthly allocation. See Table 15 in Annexure C on page 242 for a comprehensive account of the combination of energy used for heating water in the winter. Table 6.26 lists the sources of energy that are used in winter in order of popularity.

Table 6.26: Energy use for heating water in the winter

ENERGY USE	E	FBE
Electricity	27	27
Kerosene	14	21
Firewood	14	19
Gas	7	2
Coal	1	1
Solar geyser	0	1
Heat water outside in the sun	0	0
Electric geyser	0	0

The results are similar to the question about summer with the exception of using the sun. Even the households who have SHS do not feel that they can use it reliably in winter. Again, FBE households tend to rely more on kerosene and firewood than non FBE households. The latter tend to rely more heavily on gas. As was seen in the discussion on the roll-out of the SHS in Chapter 2, some households boil their kettle up to eight times in the morning for a warm bath. Like the households in the qualitative part of the study, people prefer to use their electric kettle as it boils faster, but this either increases the household electricity bill or eats into the FBE, respectively. Households therefore have no choice but to diversify their energy use. As a result, 'fuel stacking' for water heating occurs in winter (See Table 15 again in Annexure C on page 242).

Furthermore, even though household members are aware of the health risks of kerosene, they often heat water indoors to fulfil the duel function of providing heat. Firewood, however, is rarely used indoors. Tending the heating of water outside during the day is a laborious task however and, as was seen in the case of Mrs. Magolego (FBE), it is not popular as it is cold outside. For many households this is also not an option as members work during the day (focus group discussion). Respondents were asked whether their household had to

resort to cutting back on spending energy on heating water during the year. Their answers can be seen in Table 6.27.

Table 6.27: In the last year; has your household cut back on spending on energy for heating water?

		Electricity	FBE	Total
	Very often	4	3	7
	Often	11	14	25
	Occasionally	11	7	18
	Rarely	3	4	7
	Never	1	2	3
Total		30	30	60

As can be seen from the above, most households in both categories employ money saving strategies when it comes to heating water. Marginally more FBE households indicate that they do not cut back. The reasons for cutting back is similar to those given for other energy applications but as with cooking, the higher price of kerosene is a deciding factor. As with space heating, FBE households prefer firewood to kerosene. Table 16 in Annexure C on page 242 shows a comprehensive account of the combination of strategies that are used to save on water heating. Table 6.28 lists the strategies that households use to cut back on heating water energy in order of popularity. Note that the lists are not particular to a specific season.

Table 6.28: Strategy/strategies for cutting back on spending on energy for water heating

STRATEGIES	E	FBE
We do not heat water	21	18
We only heat water slightly	15	15
We do not use the electric geyser	14	11
We leave the water outside in the sun on a hot day	12	11
We use more firewood for water heating	6	12
We use more kerosene for water heating	5	6
We use less kerosene for water heating	3	8
We wash and don't bath	2	5
We use more gas for water heating	5	0
We use less firewood for water heating	1	3
Other strategies	1	2

As can be seen with space heating, households that receive the FBE rely heavily on kerosene and firewood and tend to 'move down the energy ladder' by first using less electricity, then using less kerosene and then using more firewood. It is possible to say that this is an indication that the FBE does not meet recipient needs for water heating. This can also be seen in their response to the question on affordability of electricity for water heating and the satisfaction ratings. See Table 6.29, Table 6.30, Table 6.31 and Table 6.32 for the results.

Table 6.29: The affordability of electricity for heating water

		Electricity	FBE	Total
	Not applicable	0	1	1
	It is not affordable	20	22	42
	It is affordable	10	7	17
Total		30	30	60

Table 6.30: If you have electricity, on a scale of 0 to 4, with 0 being very dissatisfied and 4 being very satisfied, how would you rate your satisfaction with receiving electricity to meet your household's need for water heating?

		Electricity	FBE	
	Not applicable	0	1	1
	0	3	3	6
	1	10	14	24
	2	15	8	23
	3	2	2	4
	4	0	2	2
Total		30	30	60

Table 6.31: Comparing the satisfaction levels of receiving access to electricity for meeting household energy needs amongst household categories

LIGHTING		COOKING		SPACE HEATING		WATER HEATING		APPLIANCES	
NO FBE	FBE	NO FBE	FBE	NO FBE	FBE	NO FBE	FBE	NO FBE	FBE
60	60	47	47	24	24	46	44	49	59
0 pt. difference		0 pt. difference		0 pt. difference		2 pt. difference		10 pt. difference	

Table 6.32: If you have the FBE, on a scale of 0 to 4, with 0 being very dissatisfied and 4 being very satisfied, how would you rate your satisfaction with receiving the FBE to meet your household's need for water heating?				
		Electricity	FBE	Total
	Not applicable	30	0	30
	0	0	2	2
	1	0	5	5
	2	0	15	15
	3	0	6	6
	4	0	2	2
Total		30	30	60

As can be seen from Tale 6.31, even though the satisfaction of households about the ability of electricity to heat their water is not nearly as low as that of space heating, fewer FBE households are satisfied with the contribution of electricity to meet their need for heating water than non FBE households. It is clear from the satisfaction ratings listed in Table 6.32 that the majority of recipients, namely 75%, are either neutral or unhappy with the ability of the FBE to meet their need for water heating.

6.3.5 Energy use for powering appliances and other electronic devices

6.3.5.1 Energy use for powering appliances - Interviews

The bulk of the Zondi household (No FBE) use of their FBE and additional electricity spend goes towards making sure that the fridge and the deep freezer is on at all times. They also watch television with a DStv decoder (satellite box) and charge their mobile phones with the electricity. The DStv decoder is a standard definition single view decoder that connects households to a digital satellite television service from a Sub-Saharan African company, Multichoice. It offers various viewing packages ranging from R29 to R789 per month. Mrs. Zondi indicates that the costs of using an iron, a vacuum cleaner, and an electric geyser are exorbitant. Although they often cut back on using electricity for lighting, space and water heating, they prioritize their electricity use in such a way that they do not have to cut back on using the fridge and television. The only appliances that Mrs. Mazibuko (No FBE) uses

besides her double hotplate and electric kettle, is a fridge, television, and mobile phone charger. She cannot afford to have the fridge on at all times however, and she cannot afford to use an iron.

Like the Zondi household, the fridge is considered to be the most important appliance in the Mathebula house (No FBE) and it is always in use. The family also watches television with a DStv decoder, and uses a mobile phone charger. Mr. Mathebula struggles with the high electricity costs involved with using the iron and the vacuum cleaner.

Mrs. Magolego (FBE) also considers the fridge to be the most important appliance in the house and it is always in use. She also has a television, which is in use for approximately five hours a day. She and her daughter also use electricity to charge their mobile phones. Mrs. Magolego indicated that the fridge and the iron weigh heavily on her energy budget, but she is grateful for the FBE in allowing her to use the fridge.

Like the other respondents, Mr. Zuma (FBE) also consider the fridge to be the most important appliance in the house. They also watch television in conjunction with a DStv decoder and uses a DVD player. They subscribe to the Compact package of Multichoice for R360 a month. According to Mr Zuma, the introduction of the FBE has made a substantial contribution to his household's need for entertainment and has enabled them to have the fridge on all the time, which they could not afford before.

The Mosimane household (FBE) use a fridge, a television with a DStv decoder, and a mobile phone charger. Again, the fridge is the most important appliance in the house, but, according to Mrs. Mosimane, it is expensive to run even with the assistance of the FBE. They are forced to carefully manage their FBE and their own electricity spend in such a way that the fridge can operate at all times. Mrs. Mosimane says that she does not know what she would have done without the assistance of the FBE in this regard. Overall, she is happy with the contribution of the FBE to assist her household to power appliances, but she feels that appliances are costly to run. To enable to fridge to run all the time, she uses appliances as little as possible.

6.3.5.2 Energy use for powering appliances - Survey

Table 17 in Annexure C on page 245 shows the combination of appliances used by households in the survey and Table 6.33 shows the popularity of appliances across both categories.

Table 6.33: Other electronic appliances and devices in use

APPLIANCES	E	FBE
Charger for mobile phone	30	30
Television	30	29
Fridge	30	27
Iron	28	28
DVD player	14	14
DStv decoder	15	10
Deep Freezer	7	6
Laptop or computer	4	4
Hi-Fi	6	2
Table lamp	4	2
Other	0	3
Vacuum cleaner	2	0

It is surprising that more non FBE households use more appliances than households who receive the subsidy. There are even two FBE households who do not use a refrigerator. A closer inspection reveals that these households are in the 2nd highest income burden category. At first glance, the shift in appliance use which is observed with cooking appliances can therefore not be observed for other electric appliances. It seems that households who receive electricity make a point of acquiring all those household appliances that they have longed to use when they received access to electricity (focus group discussion).

Respondents were asked to indicate which appliance they consider to be the most important electric appliance (see Table 6.34). From this table, it seems that the most popular electric appliances or devices are mobile phone chargers, televisions and fridges. After that, irons, DVD players and DStv decoders are popular appliances. The most popular combination of

appliances for FBE households is the fridge, television, mobile phone charger, table lamp and iron.

Table 6.34: Which electronic appliance/device are the most important in your house?		
MOST IMPORTANT APPLIANCE	**E**	**FBE**
Fridge	27	24
Television	2	2
Deep Freezer	1	3
Iron	1	1
Laptop or computer	0	1
Other	0	1

The deep freezer is also considered to be important by some. The deep freezer makes it possible for households to take advantage of retail food specials, such as bulk meat sales, which they can store. This allows them to reduce their grocery bills in the long term (focus group discussion). Other appliances that are considered important are the television, iron, laptop, and radio. Respondents were asked if there was any appliance or device that they could not afford to use because of its high energy usage. See Table 6.35 for their response.

Table 6.35: Appliances that is prohibitive to use because of high energy consumption		
APPLIANCES	**E**	**FBE**
Iron	12	10
Deep Freezer	11	10
Fridge	6	5
Laptop or computer	5	4
Vacuum cleaner	6	1
Television	3	1
DVD player	2	2
Hi-Fi	2	1
Other	0	2
DStv decoder	0	1
Table lamp	0	1
Charger for mobile phone	0	0

The iron, deep freezer, and refrigerator are the appliances that weigh the heaviest on the household energy cost. It is also evident that slightly more non FBE households struggle than those who receive the subsidy. It seems especially true for the use of the vacuum cleaner. No household had any problem with using a mobile phone charger. The above statistics does not give a clear picture to what extent the FBE has contributed in the use of electric appliances by FBE households. Nevertheless, it is important to understand that access to electricity alone makes a large difference to poor households as they now have the ability to use some appliances, albeit sparingly. Table 18 in Annexure C on page 246 shows a comprehensive list of the benefits that households have experienced because of access to electricity. Table 6.36 shows the benefits of access to electricity for households in the survey according to popularity.

Table 6.36: The benefits of access to electricity

BENEFITS	**E**	**FBE**
We can use a fridge	26	27
We can charge our mobile phones	25	27
We can watch television	26	26
We have improved access to information	16	13
We use less dirty fuels	10	16
We have access to the internet	4	6
We have more money because we spend less on fuels	1	1

Beside the fact that access to electricity has made it possible for households in both categories to move away from dirty fuels, it is obvious that the most beneficial contribution of electricity access is the fact that it allows households to use electric appliances. Access to electricity therefore has a significant impact on improving living standards. The benefit of the 100kWh FBE then lies in the fact that it expands on these advantages.

When respondents were asked: “Which appliances can you use more now with the assistance of the FBE?” respondents answered as follows (see Table 19 in Annexure C on page 246 and Table 6.37).

Table 6.37: Appliances that can be used more with the assistance of the FBE	
APPLIANCES	**FBE**
Fridge	21
Television	21
Mobile phone charger	18
Iron	16
DVD player	5
DStv decoder	5
Deep Freezer	4

The contribution of the FBE has enabled households to use their appliances more often. Even though more FBE respondents still felt that the use of certain appliances were prohibitive, they are now able to use the fridge, television, mobile phone charger, and iron more often. Some FBE households are also able to use a washing machine (Other) which is an appliance that none of the non FBE households use. 78% of households that use a fridge, indicated that they can use their fridge more often with the assistance of the FBE. 73% of households that have a television indicated that they can watch more television with the assistance of the FBE. More than half of the households reported that they could use their mobile phone charger more often, 58% the iron, 35% the DVD player and half of those that use a DStv decoder felt they could use it more often. It can be concluded that the FBE does not revolutionize the use of electric appliances, but contributes to the comfort and living standards of beneficiary households by enabling them to use the appliances more.

Respondents were asked, “In the last year, has your household cut back on using energy for electric appliances and devices? Their answers are listed in Table 6.38.

Table 6.38: In the last year; has your household cut back on using energy for electric appliances and devices?				
		Electricity	FBE	Total
	Very often	4	2	6
	Often	13	13	26
	Occasionally	8	10	18
	Rarely	2	3	5
	Never	3	1	4
Total		30	29	59

More than half of households in both categories applied in the affirmative. The reasons for cutting back is similar to those of other energy applications. Respondents were asked: “What strategy/strategies do you use to save energy on using appliances?” See Table 20 in Annexure C on page 247 for a comprehensive account and Table 6.39 for strategies in order of popularity.

Table 6.39: Strategies employed to save energy use for powering appliances

STRATEGIES	E	FBE
We try to use the appliances as little as possible in the winter	13	11
We watch less television	9	14
Other	5	5
We only use the fridge in the summer	3	6
We only switch the fridge on during the day	2	5
We buy food that does not need refrigeration	6	1
We only switch the fridge on during a very warm day	1	0

As can be seen, seasonal poverty has a marked impact on the reason why people cut back on using appliances. The most popular strategy is to use appliances as little as possible in the winter. This is understandable, as households must find a way to minimize energy use in the winter because of higher energy costs for cooking, space and water heating. FBE households also tend to use the television less. Non FBE households tend to buy food that does not need refrigeration.

Respondents were also asked how they feel about the affordability of using electricity to power appliances and other devices. Their answers are listed in Table 6.40. Note that seven households who receive the FBE gave no data.

Table 6.40: Affordability of electricity for powering other appliances and devices

		Electricity	FBE	Total
	Not applicable	0	7	7
	It is not affordable	19	10	29
	It is affordable	11	12	23
	It is more than affordable	0	1	1
Total		30	30	60

It is unfortunately not clear from the above table whether the FBE improves the perception of the affordability of electricity for powering appliances as a result of the missing data. As with the other energy applications, respondents were also asked to rate their satisfaction with receiving electricity to meet their need for powering appliances (see Table 6.41).

Table 6.41: If you have electricity, on a scale of 0 to 4, with 0 being very dissatisfied and 4 being very satisfied, how would you rate your satisfaction with receiving electricity to meet your household's need to power appliances?

		Electricity	FBE	Total
	Not applicable	0	1	1
	0	1	1	2
	1	13	5	18
	2	12	16	28
	3	4	6	10
	4	0	1	1
Total		30	30	60

From the results of Table 6.41 it would seem that FBE households are slightly more satisfied with access to electricity than non FBE households. As can be seen from the results of Table 6.42 there is even a ten-point difference in satisfaction levels between categories. It seems that access to electricity does not in itself satisfy the need for powering appliances.

Table 6.42: Comparing the satisfaction levels of receiving access to electricity for meeting household energy needs amongst household categories

LIGHTING		COOKING		SPACE HEATING		WATER HEATING		APPLIANCES	
NO FBE	FBE	NO FBE	FBE	NO FBE	FBE	NO FBE	FBE	NO FBE	FBE
60	60	47	47	24	24	46	44	49	59
0 pt. difference		0 pt. difference		0 pt. difference		2 pt. difference		10 pt. difference	

FBE respondents were asked to rate their satisfaction with the subsidy in terms of satisfying their need for powering appliances (see Table 6.43).

Table 6.43: If you have the FBE, on a scale of 0 to 4, with 0 being very dissatisfied and 4 being very satisfied, how would you rate your satisfaction with receiving the FBE to meet your household's need to power appliances?				
		Electricity	FBE	Total
	Not applicable	30	0	30
	1	0	3	3
	2	0	9	9
	3	0	15	15
	4	0	3	3
Total		30	30	60

As can be seen, more than half of the households are quite satisfied. Table 6.44 shows a summation of the combined scores of satisfactions for all energy applications for FBE households. Respondents are happy about the fact that the FBE assists them with lighting, appliance use, and cooking, but are unhappy with space and water heating capacity.

Table 6.44: Comparing the satisfaction ratings of the contribution of the FBE to meet different household needs				
LIGHTING	**COOKING**	**SPACE HEATING**	**WATER HEATING**	**APPLIANCES**
80	74	42	53	78

6.3.6 Summary of the benefits of the FBE

6.3.6.1 Summary of benefits of the FBE - interviews

Participants in the study was asked: “If you receive the FBE, how has the FBE benefited your household?”

According to Mrs. Magolego the FBE has made a significant contribution towards improving the living standard of her and her daughter. She could not afford to leave the lights on in the evening for her children to study before. She also used mainly kerosene and fuel wood for cooking and this often made them sick. She states that she had to cut back on grocery spending to be able to afford electricity. The FBE has enabled her to have the fridge on

constantly, and allows her child to have access to the internet. They have also learned a lot by watching educational programs on television. Additionally, they can put their savings towards transport.

According to Mr Zuma, access to electricity has given his children the opportunity to gain knowledge through educational programs on television and has allowed them to easily run appliances allowing them to watch television for as long as they want. Despite the fact that they use multiple energy sources, the FBE has made it possible for them to make less use of dirty fuels as they can use a double hotplate several times a week. They also save a little money sometimes that they put towards transport and other essential expenses.

Mrs. Mosimane states that the FBE has enabled her household to have a higher standard of living. It has enabled them to watch television more often and use the fridge properly. It has also freed up money that can be put towards buying more groceries such as food and toiletries, and assists with paying for transport. Previously, they had to ask their neighbours to assist them with transport money. They are also able to afford to take part in a ‘Stokvel’, which helps them cope with the demands of the holiday season. A ‘Stokvel’ is a grassroots credit scheme where a group of about ten people who know and trust each other combine their financial resources by contributing to a central fund that is then paid out to each member on a rotating monthly or weekly basis.

As already mentioned, Mrs. Khoza said that the FBE enabled her to cook ‘mielie rice’ more often and she is happy with the impact that the FBE has on meeting her household’s cooking needs. According to her, the FBE has increased household living standards as it has enabled her to access news and information through the television and radio. It has also decreased their use of dirty fuels and allowed them to buy and store food in bulk in a constantly running fridge. This means they can save on their food bill.

As can be seen, similar benefits are mentioned by most households. Note the reference to the FBE assisting with transport. According to the participants in the focus group discussion, adequate funds for traveling is important in Soshanguve. The cheapest form of transport is the train, but the train station in Makopane is far for some people to walk to. To save time to get to the station people have to take a taxi which is expensive. The second cheapest mode of transport is the buses, but they are not as convenient as taxis as they have limited routes.

To save time in walking to the station and bus depot, adequate funds for a taxi is essential. Be that as it may, the preferred mode of transport is taxis, but as a taxi from Soshanguve to the city centre costs approximately R60 (2016), this is expensive. When respondents note that the FBE has enable them to have additional money for transport, the beneficial impact on their living standards cannot be overstated (focus group discussion). The frequency 'cost of travelling' as a reason for cutting back on fuel use for specific household applications amongst non FBE households must then also be regarded in this context.

6.3.6.1 Benefits of the FBE – Survey

The answers to the question "If you receive the FBE, how has the FBE benefited your household?" is listed in Table 6.45. It must be mentioned that the questionnaire provided respondents with a list of choices, but they were encouraged to provide their own answers under 'Other'. Only a few respondents made use of this selection (see Table 21 in Annexure C on page 248).

Table 6.45: The benefits of the FBE	
We can have the fridge on all the time	23
We can watch television for as long as we like	19
We can leave the lights on for longer	13
We can use appliances that we could not use before	13
We use less dirty fuels	10
We can afford to cook dishes that we could not afford before	7
We have more money to spend on groceries	6
We have more money for education	3
We have more money for medical expenses	2
Other	1

The largest contribution of the FBE again seems to be its ability to assist the beneficiaries in having the fridge run constantly. The second most mentioned benefit was the fact that households did not have to economise when it came to watching television. The third and fourth most mentioned benefit was the fact that household could have their lights on for longer and that they could use appliances that they could not use before. Only seven households felt that they were able to cook dishes that they could not cook before and only

a few households reported that they had more money to spend on groceries and/or medical expenses and/or education. Unfortunately, the ability to be able to travel more often, did not come up during the survey.

In summary, the most appreciated change was that the 100kWh enabled them to use appliances like the fridge, television, and other appliances such as a washing machine more often. It also enabled them to leave the lights on for longer periods.

6.4 The impact of the 100kWh FBE on the incidence of multiple fuel use and 'fuel stacking'

6.4.1 Determinants of fuel use from the household ECHDE

To understand household decisions about energy selection and how they use it, it is important to understand the factors that influence household energy choice in Soshanguve.

Firstly, the Zondi household's choice of kerosene and firewood is as a result of the affordability of these fuels. It is also evident that their use of kerosene and firewood in an outdoor shelter is a result of their awareness of the health impacts of indoor use. Gas is used indoors. To save electricity on lighting, they use candles and kerosene. To cut back on space and water heating expenses they use more kerosene. They also use more kerosene than anything else for cooking when they run short on money or when their energy demands are higher in the winter.

Mrs. Mazibuko diversifies her energy for lighting by using candles and kerosene – the former being the favoured and most affordable option. She already diversifies her energy for cooking by using electricity and kerosene. She does not use her kerosene stove outside however, so she seems to be unaware of its health impacts. When she is financially pressed, she uses kerosene for cooking and firewood for water heating. The reasons for using these fuels is because it is affordable, and firewood is readily available from the local vendors in Block Y.

The Mathebula household use electricity as much as they can, but prefer to use wood to cook their traditional dishes as they prefer the taste of food prepared this way. In their case,

culture and tradition play an important role in their preference of food preparation. They use kerosene for space heating in winter. This seems to indicate that they are unaware of the health risks of indoor kerosene use, but this is not the case. One of the biggest expectations Mr. Mathebula has for receiving the FBE is that his household will not be fully reliant on the kerosene heater in the winter. He stated that he is aware of the risk of kerosene. For water heating, the family alternates between wood and gas. Wood is affordable for them and gas heats water quickly. However, as Mr Mathebula considers gas to be expensive, they use it as sparingly as possible.

In the case of Mrs. Mkhize who had to resort to opening a crèche to supplement her income, she was compelled to use the cheapest from of fuel, namely wood, to prepare lunch for her charges. She erected an outdoor shelter for cooking *pap* and meat for the children. In her case, the incidence of livelihood vulnerability forced her to move 'down the energy ladder'.
In the case of Mrs. Magolego (FBE), candles and a kerosene lamp are used only during load-shedding and not as a form of diversification. Otherwise, she uses electricity. She uses kerosene to diversify her use of energy for cooking. As a backup during load-shedding she is also forced to use firewood for cooking which she does not normally use. Like her neighbour, Mr. Mathebula, she also uses a kerosene heater in winter and she prefers to use firewood in the summer to heat water. Accordingly, her choice of energy is influenced by the convenience of a fuel. According to her, she uses electricity because it is convenient and because it is a healthier fuel. However, she uses kerosene because of its affordability. She knows that the use of kerosene has negative health impacts on her household and laments the fact that she is still forced to use it to meet her energy needs.

Mr. Zuma has a large family and feels the need to diversify energy as much as possible to keep his electricity costs down. As a result, Mr. Zuma's household has the largest incidence of 'fuel-stacking' of all the participants in the qualitative study. Mr. Zuma does not diversify energy use for lighting, as he prefers to use electricity. He only uses candles during load-shedding. He struggles to meet his large household's energy needs for cooking, space and water heating. As a result, his household uses electricity, firewood, and kerosene for cooking. Firewood is used to prepare pap and other traditional dishes. Consequently, kerosene is mostly used for heating water for cooking. Culture plays a role in the household's cooking fuel choice. The household formally used coal for space heating, but they stopped using it as supply became unavailable. They sometimes use firewood for heating. The

household now only use firewood for water heating, as the FBE is allocated to other appliances. Mr. Zuma finds electricity convenient and his main reason for using firewood and kerosene is affordability. He would like to use gas in the future because he is aware that kerosene is unhealthy. Mr. Zuma is upset about the fact that so many people in Soshanguve use electricity illegally. He is of the opinion that it is unfair to households like his who are honest users.

Mrs. Mosimane diversifies her energy use for lighting with candles, which she considers to be affordable. She also diversifies her energy use for cooking by alternatively using electricity and kerosene. She does not have a problem with the taste of food prepared with kerosene and she does not use firewood. This underlines the unique nature of the HDE of different households. Mrs. Mosimane also alternates between electricity and kerosene for space and water heating. She would prefer to use gas to meet her energy needs in the future as she believes it is a healthier fuel than kerosene and also because it allows for faster cooking.

Mrs. Khoza's household mostly uses electricity for lighting, but they sometimes stretch their FBE by making use of candles. Like Mrs. Mosimane, she alternates between using electricity and kerosene for cooking, and space and water heating. She says that she uses electricity because it is convenient and candles and kerosene because it is affordable, and it helps her manage her FBE.

The most mentioned energy sources in the survey was electricity, kerosene, and firewood. Table 6.46 shows the reasons for using electricity. See Table 22 to 26 in Annexure C on page 249 to page 251 for a comprehensive account of reasons why respondents use certain fuels.

Table 6. 46: Reasons for using electricity

ENERGY CHOICE	E	FBE
Electricity because it is convenient	25	27
Electricity is a healthier energy to use	26	24
Electricity because food taste better when prepared with it	15	11
Electricity because it is available	9	14
Electricity use enhances one' status	11	12
Electricity because it is affordable	4	2

The most popular reason for using electricity is that it is convenient. In other words, it can be used to satisfy many household energy needs. The second most popular reason is that electricity is a healthier fuel than some other fuels. It seems that the residents of Soshanguve are aware of the health risks associated with some of these fuels. The third most popular reason is that food prepared with electricity tastes better than food cooked with kerosene. Several FBE households name the fact that electricity is 'available' as a reason for using it. In other words, household members do not have to go to lengths to buy or fetch it. The least mentioned reason was that it was 'affordable'. Tellingly, more non FBE households than FBE households stated this as a reason. Table 6.47 shows the reasons why households use kerosene.

Table 6.47: Reasons for using kerosene

ENERGY CHOICE	E	FBE
Kerosene because it is affordable	11	17
Kerosene because it is available	14	10
Kerosene because it is convenient	4	2
Kerosene because it is a healthier fuel to use	0	1

The most popular reason for using kerosene is its affordability. The second most important reason is the fact that it is available. A few households also consider it convenient and one FBE household considers kerosene a healthier fuel. One assumes that this respondent might be thinking that it is healthier to use than coal or firewood. None of the households named the reason 'because food taste better when prepared with it' or because 'its use increases one's status'. Please take note that yet again, more FBE households than non FBE households named the affordability of kerosene as their prime motivator for using it.

Table 6.48 gives a comprehensive account of firewood use by households and the reasons why they use it.

Table 6.48: Reasons for using firewood

ENERGY CHOICE	E	FBE
Firewood because it is affordable	11	16
Firewood because it is available	6	9
Firewood because it is convenient	5	6
Firewood because food taste better when prepared with it.	2	7

Households that use firewood do so mostly because of its affordability. Less mentioned reasons are that it is available and convenient. Note that many more FBE households than non FBE households indicated that they prefer to use it because the prefer the taste of food prepared with it.

6.4.2 Multiple fuel use and ‘fuel stacking’

One of the stated objectives of the FBE initiative was to assist households to move away from dirty fuels. It is clear from the above discussion that the FBE did not assist the participants in the qualitative study to do so entirely. Table 6.49 shows a comprehensive account of the incidence of multiple fuel use amongst the households in the survey that do not receive the FBE and Table 6.50 show the statistics for households that do.

Table 6.49: Multiple fuel use amongst households who do not receive the FBE																				
Respondent	LIGHTING					COOKING				SPACE HEATING					WATER HEATING					
Nr.	Electricity	Candles	Kerosene	Gas	Solar	Electricity	Kerosene	Firewood	Gas	Electricity	Kerosene	Firewood	Gas	Coal	Electricity	Kerosene	Firewood	Gas	Total
1	1	1				1		1							1		1		6
2	1	1	1			1	1	1		1	1			1			1		10
3	1		1	1	1	1	1		1		1				1			1	10
4	1	1				1	1	1							1				6
5	1	1				1	1	1				1			1	1	1		9
6	1	1				1	1	1							1	1	1		8
7	1	1				1		1							1		1		6
8	1	1				1	1	1									1		6
9	1	1				1		1		1					1		1	1	8
10	1	1				1	1								1				5
11	1	1				1	1								1				5
12	1	1				1	1		1	1					1			1	8
13	1	1				1				1					1				5
14	1	1		1		1			1						1			1	7
15	1	1				1			1	1					1				6
16	1	1	1			1		1							1		1		7
17	1	1				1	1	1								1	1		7
18	1	1				1	1				1		1		1	1			8
19	1	1				1		1							1				5
20	1	1				1	1	1							1	1	1		8

Table 6.49: Multiple fuel use amongst households who do not receive the FBE																			
Respondent	**LIGHTING**					**COOKING**				**SPACE HEATING**					**WATER HEATING**				
Nr.	**Electricity**	**Candles**	**Kerosene**	**Gas**	**Solar**	**Electricity**	**Kerosene**	**Firewood**	**Gas**	**Electricity**	**Kerosene**	**Firewood**	**Gas**	**Coal**	**Electricity**	**Kerosene**	**Firewood**	**Gas**	**Total**
21	1	1				1	1	1		1					1	1			8
22	1	1				1	1	1							1	1	1		8
23	1	1				1	1	1		1	1	1	1		1	1	1		12
24	1	1				1	1		1				1		1	1		1	9
25	1	1	1	1		1	1	1	1				1	1	1	1		1	13
26	1	1	1	1	1	1	1		1					1	1			1	11
27	1	1				1	1	1							1	1	1		8
28	1	1				1	1	1	1	1		1			1	1	1		11
29	1	1				1	1		1		1				1	1			8
30	1	1	1			1	1		1						1	1			8
Total	**30**	29	6	4	2	30	22	18	10	8	5	3	4	3	27	14	14	7	236

Table 6.50: Multiple Fuel use amongst households that receive the FBE																					
Respondent	LIGHTING					COOKING					SPACE HEATING				WATER HEATING							Total
Nr.	Electricity	Candles	Kerosene	Gas	Solar	Electricity	Kerosene	Firewood	Gas	Coal	Electricity	Kerosene	Firewood	Gas	Electricity	Kerosene	Firewood	Gas	Coal	Solar geyser	Batteries	
1	1	1				1		1			1				1		1					7
2	1	1		1		1									1			1				6
3	1	1				1		1									1					5
4	1	1	1			1	1								1	1						7
5	1	1	1			1	1	1							1	1	1					9
6	1	1			1	1		1	1						1		1				1	9
7	1	1				1	1									1						5
8	1		1			1	1		1		1				1							7
9	1	1				1	1	1							1	1	1					8
10	1	1				1		1							1		1					6
11	1	1					1	1								1	1					6
12	1	1				1									1		1					5
13	1	1				1	1	1							1	1	1					8
14	1	1				1					1				1							5
15	1				1	1	1		1			1			1	1				1		9
16	1	1				1	1					1			1	1						7
17	1	1				1	1	1							1	1	1					8
18	1	1				1	1								1	1						6
19	1	1	1		1	1	1	1				1			1	1	1					11
20	1	1				1	1	1	1						1	1						8
21	1	1				1	1	1		1	1	1	1		1	1	1		1			13
22	1			1	1	1	1					1		1	1	1		1				10

Table 6.50: Multiple Fuel use amongst households that receive the FBE																						
Respondent	**LIGHTING**					**COOKING**					**SPACE HEATING**				**WATER HEATING**							**Total**
Nr.	**Electricity**	**Candles**	**Kerosene**	**Gas**	**Solar**	**Electricity**	**Kerosene**	**Firewood**	**Gas**	**Coal**	**Electricity**	**Kerosene**	**Firewood**	**Gas**	**Electricity**	**Kerosene**	**Firewood**	**Gas**	**Coal**	**Solar geyser**	**Batteries**	
23	1	1				1	1				1				1	1						7
24	1	1				1	1	1					1		1	1	1					9
25	1	1	1			1	1	1				1			1	1	1					10
26	1	1				1									1		1					5
27	1	1				1	1	1				1			1	1	1					9
28	1	1				1	1	1				1	1		1	1	1					10
29	1	1	1			1	1	1				1	1		1	1	1					11
30	1	1				1	1	1					1		1	1	1					9
Total	30	27	6	2	4	29	22	18	4	1	5	9	5	1	27	21	19	2	1	1	1	235

In comparing this data, it becomes clear that there is no difference in the amount of energy applications for both categories for single applications. Non FBE households use a total of 236 energy applications, while FBE households have 235. Table 6.51 shows energy use for lighting, Table 6.52 the energy use for cooking, Table 6.53 the energy use for space heating, and Table 6.54 the energy use for water heating.

Table 6.51: Energy applications for lighting

	Electricity	Candles	Kerosene	Gas	Solar
NO FBE	30	29	6	4	3
FBE	30	27	6	2	4

Table 6.52: Energy applications for cooking

	Electricity	Kerosene	Firewood	Gas	Coal
NO FBE	30	22	18	10	0
FBE	29	22	18	4	1

Table 6.53: Energy applications for space heating

	Electricity	Kerosene	Firewood	Gas	Coal
NO FBE	8	5	3	4	3
FBE	5	9	5	1	0

Table 6.54: Energy applications for water heating

	Electricity	Kerosene	Firewood	Gas	Coal	Solar geyser	Batteries
NO FBE	27	14	14	7	0	0	0
FBE	27	21	19	2	1	1	1

As can be seen from the above, non FBE households use gas more often for all household needs. FBE households rely more heavily on kerosene and firewood for space and water heating. Energy use for cooking is similar across categories.

In examining the incidence of fuel stacking, however, it is clear that five households in both categories make use of six different fuels, and that non FBE households tend to fuel stack more often. The latter is especially true with gas. Nevertheless, households that receive the FBE fuel stack with dirty fuels more frequently, although they are more likely to use solar technology. Table 6.55 shows the incidence of fuel stacking amongst households.

Table 6.55: Fuel Stacking	Nr. of Fuels	E	FBE
Electricity, Candles Kerosene, Firewood, Gas and Coal	6	1	0
Electricity, Candles Kerosene, Gas, Coal and Solar	6	1	0
Electricity, Candles, Firewood, Gas, Solar lighting and Batteries	6	0	1
Electricity Candles Kerosene, Firewood and Gas	5	2	1
Electricity, Candles, Kerosene, Firewood and Coal	5	1	1
Electricity, Kerosene, Gas, Solar lighting and Solar geyser	5	0	1
Electricity, Candles, Kerosene, Firewood and Solar lighting	5	0	1
Electricity, Candles, Kerosene and Firewood	4	9	11
Electricity, Candles, Kerosene and Gas	4	5	0
Electricity, Candles, Firewood and Gas	4	1	0
Electricity, Kerosene, Gas and Solar	4	1	1
Electricity, Kerosene and Gas	3	0	1
Electricity, Candles, and Kerosene	3	2	5
Electricity, Candles and Firewood	3	4	5
Electricity, Candles and Gas	3	2	1
Electricity and Candles	2	1	1
Total		30	30

Consequently, the results of the study show that the FBE has not enabled households to move away from dirty fuels. In fact, FBE households tend to fuel stack with dirty fuels specifically for space and water heating. Nevertheless, a third of respondents indicate that the FBE assisted them to be able to use dirty fuels less often. Take note, however, that this implies that two thirds of households were not able to do so. Also, when households where asked: “What is the consequences of energy poverty for your households?”, many respondents mentioned that the use of dirty fuels is a factor. The data show that FBE households have a greater tendency to complain about the use of dirty fuels than those who do not receive it. Tables 6.56, 6.57 and 6.58 show the responses across the different categories.

Table 6.56: Using dirty fuels is affecting the health of the cook				
		Electricity	FBE	Total
	No	26	18	44
	Yes	4	12	16
Total		30	30	60

Table 6.57: Using dirty fuels is affecting the health of the children				
		Electricity	FBE	Total
	No	25	18	43
	Yes	5	12	17
Total		30	30	60

Table 6.58: Using dirty fuels is affecting the health of all of us				
		Electricity	FBE	Total
	No	24	15	39
	Yes	6	15	21
Total		30	30	60

The fact that more respondents from FBE households indicate unhappiness with regard to the health effects of dirty fuels shows that it is clearly an issue for them. This may be due to higher expectations that accompany the initial reception of the FBE.

6.5 The impact of the 100kWh FBE on household seasonal poverty

6.5.1 Introduction

According to the data, fuel choice and expenditure is highly dependent on the season. In the summer, from November to February, the days are longer, meaning that the need for artificial lighting, warm living spaces, and heated water is reduced. Consequently, households find it easy to manage their 100kWh, barring unforeseen circumstances such as financial emergencies, fluctuations in energy, transportation or grocery prices. The highest priority for FBE households in summer is keeping the fridge running at all times. In the winter, from May to August, the days are shorter, meaning that households use more energy for lighting and every type of heating. The only benefit that FBE households have in winter, with regards to energy saving, is that the fridge does not have to be one all the time.

To verify the degree to which households experience seasonal poverty, the respondents were asked to give a comprehensive account of the amount they spend on electricity and other fuels in summer and winter. Based on this, it was possible to calculate the percentage of household energy spend. Household energy expenditure will be examined in this section. Note that not all respondents gave detailed accounts of their expenditure. Data is lacking from three non FBE households.

6.5.2 Total spend on electricity in summer and winter.

Table 6.59 shows the percentage of electricity expenditure in the summer.

Table 6.59: If you have electricity, what percentage of your total household income do you spend on electricity in the summer?

		Electricity	FBE	Total
	0% to 4%	0	2	2
	5%	3	9	12
	10%	11	12	23
	15%	3	2	5
	20%	5	2	7
	25%	3	1	4
	30%	2	1	3
	40%	0	1	1
Total		27	30	57

Almost a third of households in both categories spend approximately 10% of their budget on electricity in the summer. At the same time, a third of FBE households spend 5% or less on electricity with more than half of the twenty-seven non FBE households spending 15% or more. Taking the low-income burden of the two non FBE households into consideration, it becomes clear that the FBE makes a marked impact on assisting households in the summer. Table 6.60 shows data for winter.

Table 6.60: If you have electricity, what percentage of your total household income do you spend on electricity in the winter?				
		Electricity	FBE	Total
	0% to 4%	0	2	2
	5%	0	2	2
	10%	11	14	25
	15%	4	3	7
	20%	5	5	10
	25%	1	2	3
	30%	1	2	3
	40%	4	0	4
	50% plus	1	0	1
Total		27	30	57

In the winter, eighteen FBE households, spend 10% or less of their total income on electricity, compared to eleven non FBE households. At the same time, no FBE households spend more than 30% of their income on electricity, whilst five non FBE households do. Despite the fact that the percentage of income expenditure increases in winter for all households, FBE households are clearly better off. Table 6.61 shows the difference between summer and winter expenditure.

Table 6.61: Percentage difference between summer and winter spend on electricity				
		Electricity	FBE	Total
	0%	10	14	24
	5%	8	8	16
	10%	5	4	9
	15%	3	3	6
	20%	1	0	1
Total		27	29	56

As can be seen, the same number of households in each category experience the same increase in energy expenditure in the winter. Because of the missing data, the difference of four households in the 0% category cannot be relevant. It would seem that the FBE does not give the households an advantage with higher electricity costs in winter. It must be noted

however, that at least a third of households in both categories do not increase their electricity spend in the winter at all.

6.5.3 Total expenditure on ‘other energy sources’ in summer and winter

Table 6.62 shows the percentage expenditure on ‘other energy sources’ in the summer.

Table 6.62: What percentage of your total household income do you spend on other energy sources in the summer?

		Electricity	FBE	Total
	0% to 4%	8	7	15
	5%	6	10	16
	10%	9	11	20
	20%	2	1	3
	30%	2	1	3
Total		27	30	57

As can be seen from Table 5.62, household spend on ‘other fuels’ is remarkable similar in the summer. Also notable is that households spend less of their total income on ‘other’ energy sources. It is thus clear how much more expensive electricity is for households than the use of ‘other’ fuels. Table 6.63 shows results for the winter.

Table 6.63: What percentage of your total household income do you spend on other energy sources in the winter?

		Electricity	FBE	Total
	0% to 4%	6	5	11
	5%	7	7	14
	10%	5	9	14
	15%	3	2	5
	20%	3	5	8
	30%	1	1	2
	40%	2	1	3
Total		27	30	57

Again, the results are similar across categories. Table 6.64 illustrates the difference between the seasons for 'other' energy use.

Table 6.64: Percentage difference between summer and winter spend on other energy sources

		Electricity	FBE	Total
	0%	16	16	32
	2 to 3%	2	1	3
	5%	2	6	8
	10%	7	6	13
	15%	0	1	1
Total		27	30	57

Again, as a result of the lack of data it is not possible to make accurate assumptions from such a small sample, but it seems that the majority of households in both categories spend the same amount on 'other' fuels between the seasons. At least eleven non FBE households and fourteen FBE households, spend more on 'other' fuels in the winter. That mean that roughly 50% of households that receive the FBE spend more on 'other fuels' in the winter.

6.5.4 Total expenditure on all energy sources in summer and winter

Table 6.65 presents the total expenditure on all energy sources in the summer.

Table 6.65: What percentage of your total household income do you spend on energy in the summer?

		Electricity	FBE	Total
	10%	3	6	9
	15%	6	10	16
	20%	8	4	12
	25%	3	2	5
	30%	3	2	5
	35%	1	2	3
	40%	2	1	3
	50%	2	2	4
Total		28	29	57

In considering the above data, it is important to remember that the UN considers a household 'energy poor' if they spend more than 10% of their total household income on energy. As can be seen from the above table, all the households in the study are 'energy poor' in the summer, even though energy need is not acute in this season. Almost half of all households spend between 15% to 20% of their household income on energy in the summer, while a third of the households spend more than 25% of their income on energy. No great difference can be seen across categories for total energy spend in the summer.

It is no surprise that energy poverty increases dramatically in winter. Table 6.66 shows the percentage of total household expenditure on all energy sources in the winter.

Table 6.66: What percentage of your total household income do you spend on energy in the winter?

		Electricity	FBE	Total
	5%	0	2	2
	10%	1	2	3
	15%	4	7	11
	20%	2	4	6
	25%	6	4	10
	30%	6	5	11
	35%	2	1	3
	40%	2	3	5
	50%	4	1	5
	More than 50%	2	1	3
Total		29	30	59

All households experience acute energy poverty in winter, as they are forced to spend over 40% of their total household income. FBE households are slightly better off in the winter with only 25% of households that receive the FBE spending more than 25% of their budgets on energy compared to 55% of households who do not receive the FBE. This is a statistically significant result.

Table 6.67 shows the difference between summer and winter spend on all energy sources.

Table 6. 67: Percentage difference spend between summer and winter for all energy sources				
		Electricity	FBE	Total
	0%	4	8	12
	2 to 3%	2	0	2
	5%	6	9	15
	10%	6	4	10
	15%	6	3	9
	20%	2	1	3
	25%	1	0	1
Total		27	25	52

Despite the gaps in data, it is possible to say that FBE households are more capable of coping with seasonal pressure on energy expenditure. Four more FBE households have no difference between their summer and winter spend, and seventeen households experience a difference of 5% or less between the seasons compared to twelve non FBE households. At the same time, half of the non FBE households experience a leap of 10% upwards between the seasons, while only eight FBE households experience this. Even if the missing data is presumed to fall in the 10% or above category, it would still mean that households who receive the FBE are better able to cope with seasonal poverty than those that do not.

In conclusion, even though energy poverty is high for the study households, FBE households seem to have slightly lower levels of energy poverty. The largest advantage of the FBE is electricity use during the summer months. During this time, FBE households spend 5% or less on electricity whilst more than half of the twenty-seven non FBE households spend 25% or more. The overall statistics show that households that receive the FBE spend 25% less of their budgets on electricity in the summer than households who do not.

In the winter, the FBE aids households to keep their costs down. Despite the higher winter expenditure for all households, FBE households still spend 15% less of their income on electricity. The improvement between the difference in energy spend between the seasons are very slight and difficult to determine, but based on the available statistics, households that receive the FBE only show a slight improvement of 5%.

Because of the small sample size, it is not possible to paint an accurate picture of what households spend on alternative energy sources. Be that as it may, it seems that non FBE households spend a larger part of their income on 'other' fuels in the summer than FBE households, and FBE households spend more on these in the winter. The results are inconclusive.

6.5.5 Coping with seasonal poverty

Respondents were asked: "How do you afford the extra you spend on energy (electricity and 'other fuels') in the winter?". Note that respondents were given a list of options, but were afforded the opportunity to add their own strategy under the 'Other' option. Several respondents chose the latter option. Table 6.68 lists strategies according to popularity.

Table 6.68: Strategies to cope with higher spend on energy in the winter

STRATEGIES	E	FBE
We spend less money on groceries	22	21
We spend less money on traveling	12	6
We use cheaper fuels	2	4
We buy more cooked meals	3	2
We use appliances as little as possible	0	3
We use more gas	2	0
Why buy canned food	2	0
We buy more canned food and cereals	1	0
We cook food in bulk	1	0
We only heat food slightly before eating	1	0
Family members sometimes help out by giving us money	1	0
We use cheaper fuels for heating water	0	1
We switch off all unused appliances	0	1
I do extra jobs in the winter	0	1
We collect empties to make extra money	0	1
I sell Avon to earn extra money	0	1
We limit cooking	1	0
We don't use the fridge	1	0

The most popular strategy is to cut back on grocery spending. The second most popular strategy, especially employed by non FBE households is to limit spending on transport. As already discussed, this is a significant indicator of living standards and seem to indicate that

the FBE makes a positive contribution to households' living standards. The third most popular strategy is to use cheaper fuels.

Note that most households use a combination of the above to cope with seasonal poverty (see Table 27 in Annexure C on page 252). Strategies that are the most often combined are limiting appliance use, purchasing non-perishable food, doing extra jobs in winter, or relying on family members for financial aid.

6.6 The consequences of energy poverty

Even though the FBE makes a definite contribution to improving lives, the high cost of energy has a devastating impact on the living standards of the poor. Table 6.69 lists the perceived consequences of energy poverty. Note that it is the researcher's opinion as well as the field assistants that people responded to consequences that are related to their poverty condition in general and not necessarily their energy poverty (focus group discussion). A comprehensive list of the combination of consequences can be seen in Table 28 in Annexure C on page 253.

Table 6.69: The consequences of energy poverty		
CONSEQUENCES	**E**	**FBE**
I cannot afford to buy enough food for my family	23	20
I spend a lot of time shopping looking for cheaper food	18	16
I cannot afford to buy nutritious food	17	16
I cannot afford to pay medical bills	11	14
It is making me feel depressed, low, hopeless and desperate	12	11
It made my children's education unaffordable	11	11
I spend a lot of time gathering/buying energy	9	13
Using dirty fuels is affecting the health of all of us	6	15
I cannot afford to pay for customary social events such a s weddings etc.	9	12
Using dirty fuels is affecting the health of the children	5	12
Using dirty fuels is affecting the health of the cook	4	12
I don't have enough money for transport	10	5
I cannot buy essential things for a decent living	4	6
My relationship with family members is suffering because of energy poverty	4	3
It is affecting my standing in the community	2	3
It made my own education unaffordable	0	4
It made my family more vulnerable to crime	0	1

From the above, it seems that the most named consequence of poverty is that households cannot afford to buy enough food for their households and that members spend a lot of their time shopping to find more affordable options. The next consequence is that they cannot afford medical bills. Poverty also has an impact on the psychological wellbeing of individuals. Many respondents reported that they suffer from depression and a few reported that energy poverty was affecting their relationships and their standing in the community. Furthermore, they felt that energy poverty hampered the education of their children.

Interestingly, each of these consequences were mentioned by respondents in both categories. The consequences that were most prevalent amongst FBE households were: a

concern for the health of the household due to dirty fuels, that they spend a lot of time gathering or buying energy, the fact that the household could not afford to pay for social events (e.g. weddings), and that it has made education unaffordable.

6.7 The residents of Soshanguve speak

As respondents were not financially compensated for participating in the study, they welcomed the opportunity that the survey afforded them to 'send a message to government'. The questionnaire presented them with six predetermined options, which were identified during the qualitative part of the survey as options that interest participants. Participants were asked to limit their selections to two options. They were also encouraged to provide their own input and suggestions. The questionnaire options were:

- Provide all RDP houses with solar geysers
- Provide all households with a subsidy for purchasing solar geysers
- Provide a subsidy for purchasing solar cookers
- Provide a subsidy for gas
- Provide a subsidy for kerosene
- Provide a subsidy to purchase generators

A comprehensive list of the combination of their choices can be seen in Table 29 in Annexure C on page 257. Table 6.70 lists their responses in order of popularity.

Table 6.70: What do you think government should do to help you?

STRATEGIES	E	FBE
Provide all RDP houses with solar geysers	16	20
Provide a subsidy for purchasing solar cookers	11	19
Provide all households with a subsidy for purchasing solar geysers	17	8
Provide a subsidy for gas	9	3
Provide a subsidy for kerosene	2	0
Provide a subsidy to purchase generators	1	1

Most respondents felt that solar geysers were important and that government should either provide all RDP houses with solar geysers or that they should subsidise all poor households to be able to purchase one. Non FBE households were especially concerned about the

latter, while FBE households were concerned about the former. It is clear that the community of Soshanguve value the use of solar geysers. According to 'Ms. G. Zuma' "Everybody knows that you save a lot of money when you have a solar geyser. People in the old RDP houses are very upset that they are giving new RDP houses solar geysers. Everybody wants solar because it is free energy" (Interview on 12 August 2016).

The second most popular choice for FBE households is to: "Provide a subsidy to purchase solar cookers". The researcher included this option in the survey, as one of the non-electrified households in the original qualitative study used a box type solar cooker. The researcher was under the impression that solar cooker technology was known to the residents of Soshanguve. However, during the focus group discussion, it became apparent that the field assistants felt that their respondents did not know what a solar cooker was. One field assistant stated: "They chose this as an option because it had the word 'solar' in it. If it is solar they want it because they see it as free energy." It is interesting that more FBE households than non FBE households selected this option. This might be as a result of the disillusionment with the FBE to fully meet their cooking needs.

Non FBE households indicated that they would appreciate a subsidy for gas. As this category uses more gas than FBE households, this is unsurprising. Two households in this category also wanted a subsidy for kerosene, and one household in each category felt that the government should subsidise generators. This is possibly in reaction to load-shedding.

When participants were asked for their own input about what government could do, certain themes emerged. The main themes are:

- Respondents are concerned about unemployment and feel that they would not have to be dependent on government support if they earned a decent income.
- Respondents felt that the rent and municipal rates were exorbitant, and they were unable to cope with payments.
- Respondents are unhappy about the fact that non-payment of residential bills result in electricity connections being cut.
- Respondents are concerned about the rising costs of electricity and respondents that receive the FBE felt that either the amount of FBE must be increased or electricity prices should come down.
- Respondents want an increase in the amount of FBE.

- Respondents want to the contract between Eskom and the municipality to be cancelled as they want to buy their electricity directly form Eskom and not from the municipality. According to the field assistants in the focus group discussion, this was the most pressing concern for the residents of Soshanguve.

6.8 Conclusion

This chapter analysed the data from the quantitative and qualitative parts of the study. Firstly, the participants of the quantitative part of the study was introduced as well as certain factors in their HDE. Thereafter the demography and HDE of the participants of the survey were examined.

Data relating to the first objective, namely: ‘to investigate the impact of the 100kWh FBE on household energy use and living standards for meeting lighting, cooking, space and water heating and powering appliances,’ were examined. Data concerning energy use for lighting, cooking, space and water heating was correlated for FBE and non FBE households. The impact of the 100kWh FBE on the energy use of the different applications was discussed.
Data relating to the second objective, namely: ’to establish the impact of the 100kWh FBE on the incidence of multiple fuel use and ‘fuel stacking’ for households who receive it,’ were examined. The discussion of multiple fuel use was introduced by examining the factors in the HDE that influence the energy decision-making of the study households. The incidence of multiple fuel use and ‘fuel stacking’ was then discussed by comparing the incidence of multiple fuel across both categories. Thereafter, the discussion focused on the vulnerability dimension of household fuel use. This was guided by the third objective, namely: ‘to establish the impact of the 100kWh FBE on household seasonal poverty.’

Lastly, the incidence on energy poverty in general and respondent suggestions were examined. A full summary of all the major findings in this chapter will be discussed in the following chapter.

CHAPTER 7
SUMMARY, FINDINGS, RECOMMENDATIONS AND CONCLUSION

7.1 Introduction

The findings of this study are summarised in this chapter. Firstly, the context of the study is described by detailing the issue of energy poverty, sustainable development, and the importance of access to 'clean' fuels in order to improve the living standards of poor households. The efforts of the South African government to ensure that the population have access to house, security and comfort will be summarised alongside efforts to address energy poverty amongst the indigent population. The objectives of the study will again be stated, as will the most significant findings.

Lastly, recommendations and final observations will be shared to conclude the dissertation.

7.2 Summary

Access to electricity is essential to national development and the betterment of the living standards of the poor. According to the United Nations, at least one barrier to poverty can be removed when poor households gain access to electricity. The South African government's commitment to meet the energy needs of the poor started in the 1950s with the adoption of the African National Congress's Freedom Charter. Herein, the right to 'house, security and comfort' for all was stressed. This became concrete after the first democratic elections of 1994 with the launch of the Reconstruction and Development Program, which aimed to provide basic services to those who have been previously excluded.

The government adopted a National Electrification Programme in 1994 to redress the backlog in electricity access and, by 2017, 85% of South African households were connected to the grid. Nevertheless, access to electricity is not the same as the ability to be able to afford to use it. To assist households to afford electricity, the government introduced a Free Basic Electricity tariff of 50kWh for households who are considered poor. Studies show that this tariff had a slightly beneficial impact on household living standards, but it did not enable them to move away from using 'dirty' fuels such as firewood, kerosene, and coal.

By 2012, organisations such as Cosatu and Earthlife South Africa started to advocate for an increased electricity subsidy. Earthlife South Africa even suggested that the subsidy be increased to allow for 200kWh of power. At the same time, only two municipalities in South Africa subsidise more than 50kWh of free electricity to its poor, namely the City of Tshwane and the City of Johannesburg municipalities, who grant 100kWh to the poor. Nevertheless, no studies had yet been published on the impact of this higher capacity FBE on the energy use and living standards of recipients. This study sought to fill this gap by focusing on a sample group of sixty-eight households in Soshanguve (thirty-four FBE households and thirty-four non FBE households). The aim was to establish to what extent the 100kWh FBE enabled households to meet their need for lighting, cooking, space and water heating, powering appliances, reduced the use of dirty fuels, and whether it assisted them to cope better with their energy needs during the winter.

7.3 Findings

7.3.1 Objective 1: To investigate the impact of the 100kWh FBE on meeting household energy needs for lighting, cooking, space and water heating, and powering appliances

7.3.1.1 Household lighting

Access to electricity has two major impacts on households who fall within the Low LSM category. It allows them to use less dirty fuels for lighting and it allows them to use appliances more often. Except for a few households that diversify by using electricity in conjunction with candles or some other fuel, most FBE households predominantly use electricity unless financial pressures or load-shedding force them to employ alternative measures. Of all the household applications, FBE respondents are the happiest with the contribution of the subsidy in meeting their need for lighting. When FBE households are faced with the need to save electricity they resort to minimizing the use of lighting. For non FBE households, however, more drastic measures – such as going to bed early – are called for. The contribution of the FBE is clear.

7.3.1.2 Household cooking

Access to electricity has a tremendous impact on living standards by allowing households to boil water and use kitchen appliances that reduce cooking time, enable them to cook indoors, and reduce reliance on fuels that pose a health risk. For households in the low LSM category, cooking remains an energy-intensive and costly endeavour. This precludes them from using various kitchen appliances.

This study shows that the 100 kWh FBE made it possible for at least half of FBE households to make use of kitchen appliances that they could not use before. When families hear that they have been approved for the 'POP' as they call it, many households save up to purchase their dream appliance (according to Ms. Zuma, this is the standard fourplate electric stove). Unfortunately, the 100kWh FBE does not stretch far enough to enable them to use this appliance as they envisioned, and more lamentably, it does not enable them to move away from using dirty fuels for cooking. The findings reveal that the same number of households that receive the 100kWh continue to use the non-electric kettle, the kerosene stove and a cast iron pot over a wood fire as households that do not receive the FBE. Nevertheless, a third of FBE households reported that the subsidy enabled them to use less dirty fuels for cooking. Some families also changed their cooking behaviour by only using dirty fuels outdoors for cooking. Other households reported that the FBE helped them to afford to cook some dishes that they were unable to cook before. It seems then that the introduction of the FBE has led to a slight improvement in meeting household cooking needs.

7.3.1.3 Household space heating

It must be said that space heating is a luxury and not a livelihood necessity. South African winters can get very cold in some parts of the country, but in Soshanguve, the temperature seldom reaches below zero. It is quite possible for people to keep themselves warm through wearing warm clothes and covering themselves with blankets in the winter and this is what at least half of the households in the study prefer to do. This also correlates with the DoE's findings from their national household survey in 2013 (DoE, 2012).

Of all the household dwellings, shacks are the most poorly insulated. Only one FBE household lives in a shack, compared to five non FBE households. It would make sense that

these households would prefer to use some form of energy for space heating, but only two non FBE households use energy for space heating, while the FBE households do not use any energy for heating.

In no other category is the uniqueness of the household's ECHDE clearer than in the case of space heating. In correlation with national statistics, most households prefer to use a single energy source for space heating, with only a third of households using multiple fuels. Households that receive the FBE though, use kerosene and firewood more often than non FBE households. What is also surprising is that more non FBE households use electricity for space heating than FBE households. Nevertheless, on examining the frequency with which households use this electricity it becomes clear that non FBE households use it sparingly, while FBE households use it 'whenever we are cold'.

In fact, the survey shows that FBE households have a greater tendency to use energy 'whenever we are cold', which indicates that they are willing to spend more money to make sure they are comfortable in winter. The fact remains that many households use dirty fuels to ensure this comfort. The 100kWh does not stretch far enough to enable recipients to use more electricity for space heating and of all the household applications respondents are the least happy with the ability of the FBE to meet their need for space heating. It can therefore be said that the 100kWh FBE has not enabled beneficiaries to satisfy their need for space heating.

7.3.1.4 Household water heating

Energy use for water heating differs between the seasons. In summer, households do not need to bath in warm water; therefore many households heat their water in the sun. Electricity is the energy of choice for water heating amongst all households in the study. Families boil water and add it to their bathing water. As was seen in the qualitative part of the study, this strategy is popular because it enables quick access to warm water. In comparison, heating water with other fuels such as kerosene, firewood, and coal take longer and must be done outside, which is inconvenient in both seasons.

It is interesting to note that more FBE households use kerosene and firewood to heat water in summer. In winter, this increases dramatically, as these households cannot rely on the

sun. As was seen in the qualitative study, some households use firewood in the summer under a shelter to protect it from the rain, but in the winter, they use kerosene inside the house because it has the added benefit of warming the living space. According to the recipients, the 100kWh did not significantly influence their ability to satisfy their need for water heating.

7.3.1.5 Household appliance use

According to the data, the ability to use appliances was named as one of the most important contributions of the FBE. The fact that the subsidy allows the fridge to be run in conjunction with other appliances, such as the television, seems to be an important factor. It is therefore possible to say that besides the impact of the 100kWh FBE on satisfying the need for lighting, the largest impact of the subsidy is to satisfy the need for powering appliances. This is where the increase in living standards is felt the most prominently, as people have better access to entertainment and education, and allows them to constantly run a fridge. This finding is also echoed in the satisfaction ratings given by respondents regarding the ability of the FBE to meet their need for powering appliances. Some households even indicated that electricity for powering appliances is more than affordable.

It seems that the results of the study support the findings of Wickramasinghe (2011) and Victor (2002) (cited by Mncube, 2007) who state that when poor households receive access to electricity, they have a tendency to spend their meagre earnings towards improving their living conditions, especially the need for entertainment and then use cheaper fuels at the bottom rung of the energy ladder to meet their more energy intensive needs. When the need for entertainment is fulfilled, households move on to satisfy other needs such as buying irons and heaters when it becomes financially possible for them to do so. The only difference between Victor's (2002) findings and those of this study is that the need for refrigeration is much more prominent.

With regards to other benefits mentioned by FBE households, six households mentioned that the FBE made it possible for them to save money that can be put towards groceries. Three households reported that they can save money which they spend on education, and two households indicated that it has enabled them to pay medical bills.

In general, though, the study shows that the assistance of the FBE has not improved the perception of households that electricity is now generally affordable. Most households prioritise and manage their free electricity in order to make it last for as long as possible. In the case of Mr. Zuma, for instance, the free electricity lasts his family for about two weeks, in which time it is used sparingly to allow them to use it for lighting, television, phone charging, the fridge, boiling water, and occasionally, cooking. This tendency can also be seen in the case of Mrs. Khoza. This is the norm for most FBE households, although priorities differ.

Further analysis reveals that, overall, there is not a large difference in the perception of the affordability of 'other' fuels between the two categories. Both experience the affordability of candles, kerosene, firewood and other fuels as the same.

7.3.2 Objective 2: The impact of the 100kWh on multiple fuel use and 'fuel stacking'

It is clear from the study that, although the 100kWh has been beneficial in assisting households in their need for lighting and allowed them to use electric appliances more often, it has not enabled them to move away from using kerosene and firewood for cooking, space and water heating. In the case of cooking, the FBE has enable some households to use certain fuels less often, but during times of financial vulnerability, households are forced to make use of these fuels due to their affordability. Furthermore, the data analysis shows that FBE households have a greater tendency to use kerosene and firewood for space and water heating than non FBE households. It therefore cannot be said that the 100kWh FBE has made any contribution towards decreasing multiple fuel use or fuel stacking for water heating or lessening reliance on 'dirty' fuels for space heating.

7.3.3 Objective 3: The impact of the 100kWh on household seasonal poverty

As was seen in Chapter 6, households use energy differently between the seasons. Days are longer in summer, meaning that households use less electricity for lighting and water heating. The need for refrigeration is high, therefore households prioritise the use of their FBE for the fridge. The fridge is only turned off during times of financial vulnerability.

In winter, the situation is reversed. Lights are on for longer, households cannot rely on the sun for water heating, they have an increased need for warm cooked meals, and for space heating. Many households choose to forgo the use of the fridge during this period in order to use electricity elsewhere. As was seen in Chapter 5, many households already have high energy poverty in the summer, but this increases significantly in winter when households spend between 5 and 15% more of their household income on energy.

The findings show that FBE households spend less on electricity in summer than non FBE households. In the winter, the FBE improves the ability of households to reduce their costs, showing an improvement of 15% compared to non FBE households. The FBE therefore does not reduce the burden of seasonal poverty, but enables recipients to fair better than those households who do not receive the subsidy. Nevertheless, due to the small sample size, it is not possible to give a meaningful interpretation of 'other' fuel expenditure. However, it seems that non FBE households spend slightly more of their income on these fuel types in summer, while FBE households spend more in winter.

Surprisingly, there is little difference between the two categories in summer in terms of total energy expenditure. The FBE seems to give households an advantage in winter. Given the small sample size, the researcher tentatively states that the FBE slightly alleviates seasonal poverty.

7.4 Recommendations

7.4.1 Objective 1: The impact of the 100kWh FBE on meeting household needs for lighting, cooking, space and water heating and powering appliances

This study indicates that the 100kWh FBE is more than adequate to meet the needs of poor urban households in the Low LSM category for lighting and appliance use. It is, however insufficient for meeting cooking, space and water heating needs. It is debatable whether increasing the FBE to 200kWh will be adequate in this regard. Furthermore, the researcher wants to direct attention to the concerns of Wentzel (2004), who cautions against the urban/rural inequalities which are exacerbated by the allocation of higher amounts of FBE to urban areas. It also creates questions whether even the metropolitan municipalities of

Tshwane and Johannesburg will be able to allocate an increased FBE to indigent households given the current financial crisis.

Furthermore, an increase in the FBE continues to support a capital and energy intensive form of development and unless the country's national electricity supply is weaned off of coal as major energy source in favour of renewable energy sources, higher subsidies will not be in line with the country's commitment to mitigate climate change and achieve other SDGs.

The researcher is also in agreement with the opinion of Howells *et al* (2005) that the FBE distorts the energy choices of poor households by encouraging them to cook with electricity, whereas alternatives such as LP gas can deliver a similar cooking service at a lower cost. The researcher therefore recommends that the FBAE policy of providing alternative fuels be extended to include all indigent households, whether rural or urban, and that the fuel of choice should be LP gas. Studies elsewhere in the developing world has shown the effectiveness of gas subsidies to overcome energy poverty and meeting household energy needs.

Lastly, the researcher wants to highlight the issues mentioned by the residents of Soshanguve, namely that they wish to buy electricity directly from Eskom and not the municipality. As was seen, a household can get double the value for their money when they buy directly from Eskom. The possibility of reduced energy poverty and increased living standards with regards to this aspect cannot be overemphasized.

7.4.2 Objective 2: The impact of the 100kWh on multiple fuel use and 'fuel stacking'

Households use multiple fuels for cooking, and space and water heating. The findings show that FBE households tend to use more kerosene and firewood for cooking, and space and water heating. Fuel stacking is especially prevalent in the case of the latter. The researcher is of the opinion that a generous subsidy of LP gas would ameliorate the need for dirty fuels and supply indigent households with sufficient energy to meet their needs for cooking, and space and water heating.

7.4.3 Objective 3: The impact of the 100kWh on household seasonal poverty

As was seen in Chapter 6, the residents of Soshanguve desire solar geysers. The researcher therefore recommends that local government aggressively pursue the roll-out of its SWH project programme for all indigent households. SWH greatly benefits the living standards of recipients.

Furthermore, it is advised that the DoE considers the implementation of pilot test studies on the efficacy and uptake of solar cooking technology in urban areas. It is the opinion of the researcher that the use of solar cookers is beneficial to certain groups of urban dwellers, especially pensioners, or households who have someone at home during the day to mind the cooker. This will also enable poor households to cook their favourite traditional dishes which need a long time to simmer over a weekend after which it can be frozen and consumed when needed.

It is certain that solar technology can bring huge benefits to the poor, but it does not resolve the issue of seasonal poverty and the use of multiple fuels in winter. It is therefore necessary that the poor have access to a clean, efficient energy source in winter, including subsidised LP gas. Studies have shown that of all the energy sources besides electricity, this is the preferred energy source for most poor households.

7.5 Conclusion

This study investigated the impact that a 100kWh subsidy of electricity has on households who fall into the lowest living standards measure in South Africa in an urban area. The study area consisted of formal and informal areas in Soshanguve and focused on households that earn less than R4,000 a month and legally access electricity. The researcher used both qualitative and quantitative research methods for triangulation purposes. The study focused on three objectives, namely:

- To investigate the impact of the 100kWh FBE on meeting household energy needs for lighting, cooking, space and water heating and powering appliances
- To establish the impact of the 100kWh FBE on the incidence of multiple fuel use and ‘fuel stacking’ for households who receive it.

- To establish the impact of the 100kWh FBE on household seasonal poverty

The findings of the study indicate that the 100kWh was adequate to meet its beneficiaries need for lighting and powering appliances, but not for cooking, and space and water heating. It also did not enable the recipients to move away from using the dirty fuels, although some households reported that they were able to use these fuels less. The findings also indicated that, although the 100kWh does indeed assist its beneficiaries to spend less on electricity in summer, only a minimal improvement can be seen for winter.

The researcher recommended that, instead of increasing the amount of FBE allocated to households, the current FBAE policy of providing alternative fuels should be extended nationwide and include a subsidy on LP gas. A generous subsidy of LP gas will cover an indigent urban household's need for cooking, space and water heating adequately.

Possible research areas for the issue of urban energy poverty in South Africa can focus on the efficacy of solar cookers with a thermal storing capacity to meet household cooking needs. Studies in the 1990s in South Africa have shown that there is huge potential in this technology to meet the cooking needs of the poor.

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Interviews

‘Mrs. Zondi’, structured interview - 20 September 2016, follow-up structured interview on 1 October 2016.
‘Mrs. Mazibuko’, structured interview on 28 September 2016.
‘Mr. Mathebula’, structured interview on 20 September 2016 and follow-up structured interview on 28 September 2016.
‘Mrs. Mkhize’, semi-structured interview on 16 August 2016.

‘Mrs.’‘Magolego’, structured interview on 29 September 2016.
‘Mr. Zuma’, semi structured interview on 16 August 2016 and a follow-up structured interview on 23 September 2016.
‘Mrs. Mosimane’, structured interview on 2 December 2016.
‘Mrs. Khoza’, structured interview on 19 November 2016.
“Ms. G Zuma”, informal interview on 12 August 2016.

Focus group discussion

Focus group discussion on 3 November 2017 from 10:00 to 15:00 with the field assistants Goodness, Palesa, Thando, Rose, Rosina and Sarah at Kgorong building, Unisa main campus, Muckleneuk, Preller street, Pretoria

ANNEXURE A: INTERVIEW SCHEDULE

Dear Sir/Madam, please note the following:

This interview is strictly confidential and your identity will not be revealed through it or be of such a nature that anybody except the chief researcher can trace it back to you. If you feel uncomfortable about any question that I ask you, you don't have to answer the question. You can also stop the interview at any time.

Date of Visit:	
First name of Respondent	
Contact nr. of Respondent	

A DEMOGRAPHY AND HOUSEHOLD PROFILE

1 Block or Extension:

2 Household Language

Sepedi	
Setswana	
Xitsonga	
isiZulu	
Sesotho	
isiNdebele	
Tshivenda	
SiSwati	
Other	
Specify	

B LIGHTING

26 What sources of lighting are used in this household? *(Encircle all forms of lighting on Table in column nr. 26)*

27 How many hours a week do you use this form of energy for lighting in the summer? *(Fill in on Table in column nr. 27)*

28 How many hours a week do you use this form of energy for lighting in the winter? *(Fill in on the Table in column nr. 28)*

	26. All sources used for lighting	27. How many hours in a summer week?	28. How many hours in a winter week?
Electricity			
Paraffin			
Gas			
Candle			
Solar System			
Batteries			
Car batteries			
Generator (Petrol/Diesel)			
Other			
Specify			

35 How many times a week do you use it to prepare breakfast?

36 How many times a month do you use it to prepare breakfast?

	34. All appliances for cooking breakfast	35. How many times a week do you use it to prepare breakfast?	36. How many times a month do you use it to prepare breakfast?
None, we don't use any appliances to make breakfast			
Electric Kettle			
Non-electric kettle			
Toaster			
Wood Braai			
Paraffin stove			
Electric hotplates (two)			
Oven with two electric hot plates			
Electric stove with oven and four hotplates			
Electric frying pan			
Deep fryer			
Slow cooker			
Microwave			
Other			
Specify			

76 How much does the FBE allow you to save on this energy for water heating in the summer?

	73. Source of energy for heating water	74. How many hours a day?	75. Cost a month?	76. Savings in the summer?
We do not heat water in the summer				
Electricity to boil water				
Electricity for Geyser				
Paraffin				
Gas to boil water				
Gas water heater				
Coal				
Charcoal				
Firewood				
Solar geyser				
Batteries				
Car Batteries				
Generator (Petrol/Diesel)				
Other				
Specify				

94 How do you feel about the prices you are paying for the following energy sources

	Cheap	Affordable	Expensive
Electricity			
Paraffin			
Gas			
Candle			
Coal			
Firewood			
Solar system			
Batteries			
Car Batteries			
Generator (petrol/diesel)			
Other			
Specify			

101 Is electricity unaffordable, affordable or more than affordable for the following household needs?

	It is not affordable	It is affordable	It is more than affordable
Electricity for lighting			
Electricity for cooking			
Electricity for heating rooms and keeping warm			
Electricity for heating water			
Electricity for other appliances			

109 How much is your total monthly spend on the following energy sources in the winter?

	Energy Cost (In Rands)
Electricity	
Paraffin	
Gas	
Candle	
Coal	
Charcoal	
Firewood	
Solar system	
Batteries	
Car Batteries	
Generator (petrol/diesel)	
Other	
Specify	
Total amount	

111 What is the reasons why you use the following energy sources? (Choose as many as applicable)

Note: *If you choose* ***Affordable*** *it means that you find this source of energy is cheap to use or cheaper to use than other fuels*

Note: *If you choose* ***Convenient*** *it means that the energy is on hand and that you can use it for more than one purpose, for example lighting and cooking, or cooking and space heating etc.*

Note: *If you choose* ***Available*** *it means that you do not struggle to get hold of the energy and it is always available*

Note: *If you choose* ***Taste*** *it means that you prefer how this fuel makes food taste when you cook with it.*

Note: *If you choose* ***Health*** *it means that you are aware that the fuel is a healthier option to use than some other fuels*

Note: *If you choose* ***Status*** *it means that you like to use this fuel as you consider it to be a modern fuel and it enhances your status in the community when you use it.*

	Affordable	Convenient	Available	Taste	Health	Status
Electricity						
Paraffin						
Gas						
Candle						
Coal						
Charcoal						
Firewood						
Solar system						
Batteries						
Car Batteries						
Generator (petrol/diesel)						
Other						
Specify						

114 How has access to electricity (without the FBE) benefited your household? (Answer only if applicable)

Education (Formal and through Media)	
Health (Emotional, mental and physical)	
Groceries (Food, toiletries and other)	
Other Expenses (ex transport)	
Other things such as having more time, social standing, able to afford social events etc.	

115 **How has the FBE benefited your household? (Answer only if applicable)**

Education (Formal and through Media)		
Health (Mental and physical)		
Groceries (Food, Toiletries and other)		
Other Expenses (ex transport)		
Other things such as having more time, social standing, able to afford social events etc.		

ANNEXURE B: SURVEY QUESTIONNAIRE

Households that have electricity and receive the FBE

Please note: This questionnaire is in aid of a study by Ms. Karin Lourens for her Masters in Development Studies

Ms. Lourens is a Junior Lecturer in the Dept. of Development Studies,
School of Social Sciences, College of Human Sciences, Unisa
Mobile: 083 956 3925
Landline: 012 429 6871
Email: lourek@unisa.ac.za

Dear Sir/Madam, please note the following:

Thank you for agreeing to participate in this study. Note that this questionnaire is strictly confidential and that your identity will not be revealed through it. The information you give will not be able to be traced back to you.

Note that if you feel uncomfortable about any question that is asked, you don't have to answer the question.

Name of Field Assistant:	
Cell nr. Of Field Assistant:	
Date of Visit:	
First name of Respondent	
Contact nr. of Respondent	

A DEMOGRAPHY AND HOUSEHOLD PROFILE

1	**Soshanguve Block or Extension:**		*Please write the correct Bloc or extension nr. in the block*

B LIGHTING

13 What sources of lighting are used in this household? *(Choose as many as applicable)*

a. Electricity	1
b. Paraffin	2
c. Gas	3
d. Candle	4
e. Solar Energy	5

f. Batteries	6
g. Car batteries	7
h. Generator (Petrol/Diesel)	8
i. Other	9
If Other, Specify in block opposite	

Specify

18 What strategy do you use to cut back spending on lighting?

Choose as many as applicable

We use more candles	1
We use more paraffin	2
We use solar lights more	3
We go to bed early	4
Other	5
If Other, Specify in block opposite	

Specify

C COOKING

21 Which of these household appliances/cooking aids do you use to prepare meals?

Choose as many as applicable

a. We do not use any household appliances/cooking aids to prepare meals	1
b. Electric Kettle	2
c. Non-electric kettle	3
d. Paraffin stove	4
e. Cast iron pot over wood fire	5
f. Two-plate electric stove	6
g. Wonderbag	7
h. Microwave	8
i. Gas cylinder/cooker	9
j. Four-plate electric stove with oven	10
k. Deep fryer	11
l. Slow cooker	12
m. Other	13
If Other, Specify in block opposite	

Specify

How often do you use the following energy sources?

Choose as many as applicable

		Once a day	A few times a day	Once a week	About two to three times a week	A few times a month or during load-shedding
35	Electricity inside the house	1	2	3	4	5
36	Paraffin inside the house	1	2	3	4	5
37	Paraffin in the open air	1	2	3	4	5
38	Paraffin in a shack outside	1	2	3	4	5
39	Firewood inside the house	1	2	3	4	5
40	Firewood in the open air	1	2	3	4	5
41	Firewood in a shack outside	1	2	3	4	5

42	Coal inside the house	1	2	3	4	5
43	Coal in the open air	1	2	3	4	5
44	Coal in a shack outside	1	2	3	4	5
45	Charcoal inside the house	1	2	3	4	5
46	Charcoal in the open air	1	2	3	4	5
47	Charcoal in a shack outside	1	2	3	4	5
48	Gas inside the house	1	2	3	4	5
49	Solar energy inside the house	1	2	3	4	5
50	Solar energy in the open air	1	2	3	4	5
51	Generator (Petrol/Diesel)	1	2	3	4	5
52	Other	1	2	3	4	5
	If Other, Specify here…					

If you now have the FBE, how did you use energy for preparing meals <u>before</u> you received it?
Choose as many as applicable

		Once a day	A few times a day	Once a week	About two to three times a week	A few times a month or during load-shedding
83	Electricity inside the house	1	2	3	4	5
84	Paraffin inside the house	1	2	3	4	5
85	Paraffin in the open air	1	2	3	4	5
86	Paraffin in a shack outside	1	2	3	4	5
87	Firewood inside the house	1	2	3	4	5
88	Firewood in the open air	1	2	3	4	5
89	Firewood in a shack outside	1	2	3	4	5
90	Coal inside the house	1	2	3	4	5
91	Coal in the open air	1	2	3	4	5
92	Coal in a shack outside	1	2	3	4	5
93	Charcoal inside the house	1	2	3	4	5
94	Charcoal in the open air	1	2	3	4	5
95	Charcoal in a shack outside	1	2	3	4	5
96	Gas inside the house	1	2	3	4	5
97	Solar energy inside the house	1	2	3	4	5
98	Solar energy in the open air	1	2	3	4	5
99	Generator (Petrol/Diesel)	1	2	3	4	5
100	Other	1	2	3	4	5
	If Other, Specify here…					

If you now have the FBE, how did you use appliances to prepare meals before you had it?
Choose as many as applicable

		Once a day	A few times a day	Once a week	About two to three times a week	A few times a month or during load-shedding
101	Electric Kettle	1	2	3	4	5
102	Non-electric kettle	1	2	3	4	5

103	Paraffin stove	1	2	3	4	5
104	Cast iron pot over wood fire	1	2	3	4	5
105	Two-plate electric stove	1	2	3	4	5
106	Wonderbag	1	2	3	4	5
107	Microwave to heat up food	1	2	3	4	5
108	Gas cylinder/cooker	1	2	3	4	5
109	Four-plate electric stove with oven	1	2	3	4	5
110	Deep fryer	1	2	3	4	5
111	Slow cooker	1	2	3	4	5
112	Other	1	2	3	4	5
	If Other, Specify here…					

116 **What food preparation appliances can you not use or afford now that you would like to use in the future to prepare meals?**

Choose as many as applicable

a. There are no appliances that I cannot afford to use	1	
b. Gas stove	2	
c. Pressure cooker	3	
d. Deep fryer	4	
e. Two-plate electric stove	5	
f. Two-plate electric stove with oven	6	
g. Four-plate electric stove with oven	7	
h. Electric frying pan	8	
i. Slow cooker	9	
j. Microwave	10	
k. Toaster	11	
l. Electric kettle	12	
m. Pressure cooker	13	*Specify*
n. Microwave/oven combination	14	
o. Air fryer	15	
p. Other	16	
If Other, Specify in block opposite		

117 **What is the reason or reasons why you cannot use these appliances now?**

Choose as many as applicable

We do not have an electricity connection	1	
We cannot afford to buy it	2	*Specify*
We cannot afford to pay for the energy it uses	3	
Other	4	
If Other, Specify in block opposite		

D SPACE HEATING

126 **What sources of energy do you use for heating rooms and keeping warm?**

Choose as many as applicable

a. We do not use any energy for keeping warm	1
b. Electricity	2

c. Paraffin	3
d. Firewood	4
e. Coal	5
f. Gas	6
g. Solar energy	7
h. Batteries	8
i. Car Batteries	9
j. Generator (Petrol/Diesel)	10
k. Other	11
If Other, Specify in block opposite	

Specify

How often do you use energy for heating spaces and keeping warm in the winter?
Choose as many as applicable

		Not applicable	Once a week for an hour	Once a week for a few hours	Twice a week for a few hours	Most days of the week for a few hours	Whenever w are co
127	We do not use any energy for keeping warm	1	2	3	4	5	6
128	Electricity	1	2	3	4	5	6
129	Paraffin	1	2	3	4	5	6
130	Firewood	1	2	3	4	5	6
131	Coal	1	2	3	4	5	6
132	Gas	1	2	3	4	5	6
133	Solar energy	1	2	3	4	5	6
134	Batteries	1	2	3	4	5	6
135	Car Batteries	1	2	3	4	5	6
136	Generator (Petrol/Diesel)	1	2	3	4	5	6
137	Other	1	2	3	4	5	6
	If Other, Specify here…						

F ELECTRONIC APPLIANCES AND DEVICES

169 What other electronic appliances and devices do you use?
Choose as many as applicable

a. Fridge	1
b. Deep Freezer	2
c. Television	3
d. DVD player	4
e. DSTV decoder	5
f. Laptop or computer	6
g. Charger for cell phone	7
h. Table Lamp	8
i. Hi Fi	9
j. Iron	10
k. Vacuum cleaner	11
l. Other	12

Specify

If Other, Specify in block opposite	

170 Please indicate which of these appliances is the most important household appliance in your household in order of preference *(for instance television 1, fridge 2 etc.) Fill number in column 170 that says order of preference*

	All appliances used	170. Order of preference
a. Fridge	1	
b. Deep Freezer	2	
c. Television	3	
d. DVD player	4	
e. DSTV decoder	5	
f. Laptop or computer	6	
g. Charger for cell phone	7	
h. Table Lamp	8	
i. Hi Fi	9	
j. Iron	10	
k. Vacuum cleaner	11	
l. Other	12	
If Other, Specify in block opposite		

Specify

171 Which appliance or device can you not afford to use as you want because of high energy use?

Choose as many as applicable

a. Fridge	1
b. Deep Freezer	2
c. Television	3
d. DVD player	4
e. DSTV decoder	5
f. Laptop or computer	6
g. Cell phone charger	7
h. Table Lamp	8
i. Hi Fi	9
j. Iron	10
k. Vacuum cleaner	11
l. Other	12
If Other, Specify in block opposite	

Specify

172 If you receive the FBE, which of these appliances, if any, do you find you can use more with the assistance of the FBE?

Choose as many as applicable

a. Fridge	1
b. Deep Freezer	2
c. Television	3
d. DVD player	4
e. DSTV decoder	5
f. Laptop or computer	6
g. Cell phone charger	7
h. Table Lamp	8
i. Hi Fi	9
j. Iron	10
k. Vacuum cleaner	11
l. Other	12

Specify

If Other, Specify in block opposite	

175 **What strategy/strategies do you use to cut back spending money on using appliances?**
Choose as many as applicable

We only use the fridge in the summer	1	
We only switch the fridge on during the day	2	
We only switch the fridge on during very warm days	3	*Specify*
We buy food that does not need refrigeration	4	
We watch less television	5	
We try to use the appliances as little as possible in the winter	6	
Other	7	
If Other, Specify in block opposite		

G ENERGY AFFORDABILITY AND CHOICE

How do you feel about the prices you are paying for the following energy sources, if applicable?
Indicate as many as applicable

		Cheap	Affordable	Expensive	
178	Electricity	1	2	3	
179	Paraffin	1	2	3	
180	Gas	1	2	3	
181	Candle	1	2	3	
182	Coal	1	2	3	
183	Firewood	1	2	3	
184	Solar lighting	1	2	3	
185	Solar cooking	1	2	3	
186	Solar geyser	1	2	3	
187	Other Solar system	1	2	3	
188	Batteries	1	2	3	*Specify*
189	Car Batteries	1	2	3	
190	Generator (petrol/diesel)	1	2	3	
191	Other	1	2	3	
	If Other, Specify in block opposite				

If you have electricity, is electricity unaffordable, affordable or more than affordable for the followin household needs?

		It is not affordable	It is affordable	It is more than affordable
192	Electricity for lighting	1	2	3
193	Electricity for cooking	1	2	3
194	Electricity for heating rooms and keeping warm	1	2	3
195	Electricity for heating water	1	2	3
196	Electricity for powering other appliances and devices	1	2	3

271 What is your total household income?

Between R501 to R1000	1
Between R1001 to R1500	2
Between R1501 to R2000	3
Between R2001 to R2500	4
Between R2501 to R3000	5
Between R3001 to R3500	6
Between R3501 to R4000	7
More than R4001	8

276 If you have electricity, what percentage of your household budget do you spend on other energy sources in the winter?

5%	1
10%	2
20%	3
25%	4
30%	5
40%	6
50%	7
Other	8
If Other, Specify in block opposite	

Specify

277 What is the total percentage of your household income that you spend on all energy sources in the winter?

15%	1
20%	2
25%	3
30%	4
35%	5
40%	6
50%	7
Other	8
If Other, Specify in block opposite	

Specify

278 How do you manage to afford the extra you spend on energy in the winter, if applicable?

Choose as many as applicable

We spend less money on groceries	1
We spend less money on travelling	2
We buy more cooked meals	3
Other	4
If Other, Specify in block opposite	
Other	5
If Other, Specify in block opposite	

Specify

280 If you receive the FBE, how has the FBE benefited your household? (Tick only if applicable)

We can leave the lights on for longer	1
We can have the fridge on all the time	2
We have more money to spend on groceries	3
We have more money for travelling expenses	4

Specify

We have more money for medical expenses	5
We have more money for education	6
We use less dirty fuels	7
We can watch television for as long as we like	8
We can use appliances that we could not use before	9
We can afford to cook dishes that we could not afford before	10
Other	11
If other, Specify in block opposite	

282 What do you think government should do to assist people to meet their energy needs?
*(Choose **ONLY TWO** that you consider the most important)*

Provide all RDP houses with solar geysers	1
Provide all households with a subsidy for purchasing solar geysers	2
Provide a subsidy for purchasing solar cookers	3
Provide a subsidy for gas	4
Provide a subsidy for paraffin	5
Provide a subsidy to purchase generators	6
Other	7
If Other, Specify here…	

I, …….. hereby declare that the information provided in this questionnaire was given by me personally and is true and correct as of November 2016.

Signed:…… Date:……

ANNEXURE C: ADDITIONAL TABLES FOR CHAPTER 6

Table 1: Why have you cut back spending on energy for lighting?

	E	FBE	Total
The price of electricity has gone up and we had to pay school fees and cope with a financial emergency.	0	1	1
The price of electricity, kerosene, groceries and transport fees have gone up and we had to pay school fees and/or medical bills.	0	1	1
The price of electricity, groceries and transport has gone up and we had to cope with a financial emergency.	0	1	1
The price of electricity has gone up.	5	4	9
The price of electricity and groceries has gone up and we had to pay school fees and cope with a financial emergency.	2	1	3
The price of electricity and groceries has gone up and we had to cope with a financial emergency.	1	1	2
The price of electricity, groceries and transport fees have gone up and we had to pay school fees and/or medical bills.	4	6	10
The price of electricity, groceries, and transport fees have gone up.	5	0	5
The price of electricity and transport fees have gone up and we had to pay school fees and/or medical bills.	2	0	2
The price of electricity and groceries have gone up.	1	4	5
The price of electricity, gas and groceries have gone up and we cut back in the winter.	1	0	1
The price of electricity, kerosene and groceries have gone up.	1	2	3
The price of electricity, kerosene and transport fees have gone up.	1	0	1
The price of electricity and kerosene has gone up and we cut back in the winter.	1	0	1
The price of electricity, kerosene, groceries and transport fees have gone up.	2	1	3
Total	26	22	48

Table 2: How has the contribution of the FBE influenced the way you use the electric kettle?

	FBE
We did not use the electric kettle before we got the FBE, but now we use it once a day.	2
We did not use an electric kettle before we got the FBE, but now we use it a few times a day.	5
We use the electric kettle still only once a day.	1
We have changed from using the electric kettle once a day to a few times a day.	2
We have changed from using the electric kettle a few times a day to two to three times a week.	1
We still use our electric kettle a few times a day.	17
Total	28

Table 3: How has the contribution of the FBE influenced the way you use the double hotplate?	FBE
We did not have a double hotplate before but now we use one once a day.	3
We did not have a double hotplate before, but now we use one two to three times a week.	1
We did not have a double hotplate before, but now we use one a few times a day.	3
We used to only use our double hotplate once a day, but now we use it a few times a day.	1
We continue to use our double hotplate once a day.	3
We used to use our double hotplate two to three times a week, but now we use it once a day.	1
We do not use our double hotplate anymore as we replaced it with a four-plate electric stove.	1
Total	13

Table 4: How has the contribution of the FBE influenced the way you use the four-plate electric stove?	FBE
We did not have a four-plate electric stove before we received the FBE, but we now use one once a day.	6
We did not have a four-plate electric stove before we received the FBE, but we now use one two to three times a week.	2
We did not have a four-plate electric stove before we received the FBE, but we now use one a few times a day.	3
We continue to use our four-plate electric stove the same way, namely once a day.	4
We used to use our four-plate electric stove two to three times a week but now we only use it once a week.	1
We continue to use our four-plate electric stove in the same way, namely a few times a day.	2
Total	18

Table 5: Are there any appliances that you could not afford to use before you received the FBE that you can now afford to use?	FBE
We can now afford to use a double hotplate and an electric kettle.	3
We can now afford to use a four-plate electric stove and an electric kettle.	2
We can now afford to use a microwave.	2
We can now afford to use a toaster.	3
We can now afford to use a four-plate electric stove.	3
We can now afford to use a four-plate electric stove and a microwave.	2
We can now afford to use a four-plate electric stove and a toaster.	1
Total	16

Table 6: How has the contribution of the FBE influenced the way you use the gas cylinder?	FBE
We used to use a gas cylinder for cooking a few times a day, but now we use it only once a month or during load-shedding.	1
We did not use a gas cylinder for cooking before we received the FBE, but now we use it inside the house once a day.	2
We still use the gas cylinder the same way for cooking, namely inside the house once a week.	1
We did not use a gas cylinder before for cooking but now we use one once a month or during load-shedding.	1
We still use the gas cylinder the same way for cooking, namely inside the house a few times a day.	1
Total	6

Table 7: How has the contribution of the FBE influenced the way you use the non-electric kettle?	FBE
We did not use a non-electric kettle before we received the FBE, but now we use one during load shedding.	1
We did not use a non-electric kettle before we received the FBE, but now we use one a few times a day.	2
We used to use our non-electric kettle once a day, but now we use it only two to three times a week.	1
We used to use a non-electric kettle once a day, but we do not use one anymore.	1
We still use our non-electric kettle once a day.	1
We used to use a non-electric kettle two to three times a week but now we do not use one anymore.	1
We used to use our non-electric kettle a few times a day, but now we only use it once a month or during load shedding.	1
We used to use a non-electric kettle a few times a day, but now we do not use one anymore.	2
We used to use our non-electric kettle a few times a day, but now we only use it two to three times a week.	1
We still use our non-electric kettle a few times a day.	1
We used to use our non-electric kettle a few times a day, but now we only use it once a day.	2
Total	14

Table 8: How has the contribution of the FBE influenced the way you use your kerosene stove?	FBE
We did not use a kerosene stove before we received the FBE, but now we use it in a shack outside a few times a day.	1
We did not use a kerosene stove before we received the FBE, but now we us it in a shack outside about two to three times a week.	1
We did not use a kerosene stove before we received the FBE, but now we use it during load-shedding.	1
We still use the kerosene stove in the same way, namely once a week.	1
We used to use the kerosene stove once a day, but now we only use it only during load shedding.	1
We used to use the kerosene stove once a day, but now we use it two to three times a week.	1
We still use the kerosene stove in the same way, namely inside the house once a day.	1
We used to use the kerosene stove once a day, but now we only use it once a week.	1
We used to use the kerosene stove once a day inside the house, but now we use it once a day in a shack outside.	1
We used to use the kerosene stove about two to three times a week, but now we only use it only during load shedding.	1
We used to use the kerosene stove about two to three times a week, but we do not use it anymore.	1
We still use the kerosene stove in the same way, namely inside the house a few times a day.	2
We used to use the kerosene stove a few times a day, but now we only use it only once a day.	1
We used to use the kerosene stove a few times a day, but now we use it only two to three times a week.	3
We used to use the kerosene stove a few times a day, but now we only use it once a day in a shack outside.	1
We used to use the kerosene stove a few times a day, but now we use it only during load-shedding.	4
We still use the kerosene stove only during load-shedding.	1
We used to use the kerosene stove a few times a day, but now we do not use it anymore.	1
Total	24

Table 9: How has the contribution of the FBE influenced the way you use the cast iron pot over a wood fire?	FBE
We did not cook food in a cast iron pot over a wood fire before, but now we use it about two to three times a week.	2
We did not cook food before in a cast iron pot over a wood fire, but now we use it during load shedding.	4
We used to cook food in a cast iron pot over a wood fire once a day, but we do not anymore.	1
We used to cook food in a cast iron pot over a wood fire once a day, but now we only use it outside in a shack once a week.	1
We used to cook food in a cast iron pot over a wood fire once a day, but now we only use it two to three times a week.	2
We still cook food in a cast iron pot over a wood fire once a day.	1
We used to cook food in a cast iron pot over a wood fire once a day, but now we only use it only during load shedding.	1
We used to cook food in a cast iron pot over a wood fire about two to three times a week, but now we only use it during load shedding.	1
We still cook food in a cast iron pot over a wood fire about two to three times a week.	5
We used to cook food in a cast iron pot over a wood fire about two to three times a week, but not anymore.	1
We still cook food in a cast iron pot over a wood fire a few times a day.	1
Total	20

Table 10: What strategy/strategies do you use to cut back on spending on energy for cooking?	E	FBE	Total
We use less electricity, prepare food in bulk, eat leftovers, use a wonder bag, buy more cooked meals and eat food that does not need to be cooked.	1	0	1
We use less electricity but more firewood for cooking, eat leftovers, use a wonder bag and eat food that does not need to be cooked.	2	0	2
We use less electricity and gas for cooking, we eat leftovers and we eat more food that does not need to be cooked.	1	0	1
We use less electricity and gas but more firewood for cooking and we eat leftovers.	1	0	1
We use less electricity for cooking and prepare food in bulk.	1	0	1
We use less electricity and more firewood for cooking.	1	0	1
We eat more leftovers.	0	1	1
We prepare food in bulk and eat leftovers.	0	1	1

We use less kerosene for cooking and eat leftovers.	0	1	1
We use more firewood, we prepare food in bulk, we eat leftovers and we eat more food that does not need to be cooked.	0	1	1
We use a wonder bag and cook meals that do not require the use of a lot of electricity.	0	1	1
We use more gas for cooking.	0	1	1
We cook food in bulk, eat leftovers, use a wonder bag, buy more cooked meals and eat food that does not need to be cooked.	3	1	4
We use less kerosene and more firewood for cooking.	0	1	1
We use more kerosene and firewood for cooking and we eat leftovers.	0	1	1
We use more kerosene and firewood for cooking, cook food in bulk, eat leftovers, buy more cooked meals and eat food that does not need to be cooked.	0	1	1
We use more kerosene for cooking, we eat leftovers and eat food that does not need to be cooked.	0	1	1
We use less electricity for cooking, use more firewood, cook food in bulk, eat leftovers and eat more food that does not need to be cooked.	1	1	2
We use less electricity and kerosene for cooking, cook food in bulk, eat leftovers, buy more cooked meals and eat more food that does not need to be cooked.	1	1	2
We use less electricity and kerosene for cooking, eat more leftovers and buy more cooked meals.	0	1	1
We use less electricity and kerosene for cooking and we eat leftovers.	0	1	1
We use less electricity and kerosene for cooking.	1	1	2
We use less electricity for cooking.	3	1	4
We use less electricity, eat leftovers and eat more food that does not have to be cooked.	3	1	4
We use less electricity, prepare food in bulk and eat leftovers.	2	4	6
We use less electricity and more gas for cooking, cook food in bulk, eat leftovers and eat more food that does not need to be cooked.	1	1	2
We use less electricity for cooking and eat more leftovers.	4	1	5
We use less electricity and more kerosene for cooking and we eat more food that does not need to be cooked.	1	1	2
We use less electricity and more kerosene and firewood for cooking, cook food in bulk, eat leftovers, buy more cooked meals and eat more food that does not need to be cooked.	0	1	1
We use less electricity and more kerosene for cooking and we cook food in bulk.	0	1	1
We use less electricity and more kerosene and firewood for cooking and we eat more leftovers.	0	1	1
We use less electricity and more kerosene for cooking.	0	1	1
Total	27	29	56

Table 11: What source/sources of energy do you use to heat rooms and keep warm in the winter?	E	FBE	Total
Electricity, kerosene and coal	1	0	1
Electricity	5	4	9
Electricity, kerosene, firewood and gas	1	0	1
Electricity and firewood	1	0	1
Firewood	1	2	3
Kerosene	2	5	7
Kerosene and gas	1	1	2
Gas	1	0	1
Coal and gas	1	0	1
Coal	1	0	1
Electricity, kerosene and firewood	0	1	1
Kerosene and firewood	0	2	2
Total	15	15	30

Table 12: How often do you use energy sources for space heating?	E	FBE	Total
Electricity once a week for a few hours and kerosene or coal whenever we are cold	1	0	1
Electricity most days of the week for a few hours	1	1	2
Electricity once a week for an hour	1	0	1
Electricity once a week for an hour and firewood whenever we are cold	1	0	1
Electricity twice a week for a few hours	1	0	1
Electricity whenever we are cold	2	3	5
Gas most days of the week for a few hours	2	0	2
Firewood whenever we are cold	1	1	2
Kerosene whenever we are cold	1	2	3
Kerosene or gas whenever we are cold	1	0	1
Kerosene once a week for an hour	1	0	1
Coal or gas whenever we are cold	1	0	1
Coal whenever we are cold	1	0	1
Kerosene most days of the week when we are cold	0	1	1
Kerosene once a week for a few hours	0	2	2
Kerosene or firewood whenever we are cold	0	2	2
Gas whenever we are cold	0	1	1

Electricity once a week for an hour and kerosene, firewood and coal whenever we are cold	0	1	1
Total	15	14	29

Table 13: How did the introduction of the FBE change your energy use for space heating?

	FBE
We used to use firewood twice a week for a few hours, but we stopped using it.	1
We still use firewood for space heating whenever we are cold.	1
We used to use kerosene for space heating whenever we were cold, but now we use it only most days for a few hours.	1
We still use kerosene whenever we are cold, but we stopped using coal for space heating.	1
We still use kerosene once a week for a few hours for space heating.	2
We still use kerosene and firewood for space heating whenever we are cold.	1
We still use kerosene whenever we are cold, but we stopped using firewood for space heating.	1
We did not use any energy for heating spaces before we received the FBE, but now we use kerosene and coal whenever we are cold.	1
We still use electricity for space heating whenever we are cold.	1
We still use electricity for space heating whenever we are cold, but we have stopped using kerosene.	1
We used to use electricity twice a week for a few hours for space heating but now we use it most days of the week for a few hours.	1
We still use electricity for space heating once a week for an hour and kerosene, firewood and coal whenever we are cold.	1
We still do not use any energy for space heating.	15
We did not use any energy for heating spaces before but now we use electricity whenever we are cold.	1
Total	29

Table 14: What source or combination of energy sources do you use for heating water in the summer?

	E	FBE	Total
Kerosene and firewood	0	1	1
Kerosene, firewood and we heat water outside in the sun	0	2	2
Electricity and the solar geyser	0	1	1
Electricity, firewood and we heat water outside in the sun	0	1	1
Electricity, kerosene, the solar geyser and we heat water outside in the sun	0	1	1

Electricity, kerosene and the solar geyser	0	1	1
Electricity, kerosene, coal, firewood and we heat water outside in the sun	0	1	1
Kerosene and we heat water outside in the sun	1	0	1
We heat water outside in the sun	1	1	2
Firewood and we heat water outside in the sun	1	1	2
Electricity, gas and we heat water outside in the sun	2	0	2
Electricity, kerosene, firewood and we heat water outside in the sun	1	3	4
Electricity, kerosene and we heat water outside in the sun	3	5	8
Electricity and kerosene	3	3	6
Electricity	7	2	9
Electricity, gas and firewood	1	0	1
Electricity, kerosene and firewood	4	2	6
Electricity and we heat water outside in the sun	0	1	1
Electricity and gas	2	1	3
Electricity and firewood	3	3	6
Total	29	30	59

Table 15: What source of energy do you use for heating water in the winter?

	E	FBE	Total
Only kerosene	0	1	1
Electricity to boil water, firewood and batteries	0	1	1
Electricity to boil water, kerosene and solar geyser	0	1	1
Electricity to boil water, kerosene, coal and firewood	0	1	1
Kerosene and firewood	1	1	2
Only firewood	2	1	3
Electricity to boil water, gas and firewood	1	0	1
Only electricity to boil water	6	2	8
Electricity to boil water and gas	3	1	4
Electricity to boil water and firewood	3	4	7
Electricity to boil water, kerosene and coal	1	0	1
Electricity to boil water and kerosene	3	5	8
Electricity to boil water, kerosene and firewood	8	11	19
Electricity to boil water, kerosene and gas	2	1	3
Total	30	30	60

Table 16: What strategy/strategies do you use to cut back on spending on energy for water heating?			
	E	FBE	Total
We use more kerosene and firewood for water heating.	0	1	1
We use more kerosene and firewood and only heat the water slightly.	0	1	1
We heat the water only slightly and we wash and do not bath.	0	1	1
We do not use the electric geyser, we use more firewood, heat the water only slightly, wash and do not bath and we leave water outside in the sun to heat.	0	1	1
We do not use the electric geyser and we wash and do not bath.	0	1	1
We do not use the electric geyser, we use less kerosene and more firewood, heat the water only slightly and we leave the water outside in the sun.	0	1	1
We do not use the electric geyser, we use less kerosene, more firewood, heat the water only slightly, wash and do not bath and we leave the water outside in the sun.	0	1	1
We do not use the electric geyser, we use less kerosene and firewood, we wash and do not bath and we leave water outside in the sun.	0	1	1
We do not heat water for washing, we use more firewood and we leave water outside in the sun.	0	1	1
We do not heat water for washing and we use less kerosene.	0	1	1
We do not heat water for washing, we use less kerosene and firewood, we only heat the water slightly and we leave the water outside in the sun.	0	1	1
We do not heat water for washing, we use less kerosene and more firewood, and we only heat the water slightly.	0	1	1
We do not heat water for washing, we use more kerosene, we only heat the water slightly and we leave the water outside in the sun.	0	1	1
We do not heat water for washing, we use more kerosene and we leave the water outside in the sun.	0	1	1
We do not heat water for washing, we use more kerosene and firewood and we heat the water only slightly.	0	1	1
We do not heat water, we use less kerosene and we only heat the water slightly.	0	1	1
We do not heat water for washing.	0	2	2
We do not heat water, we only heat the water slightly and we leave the water outside in the sun.	0	1	1
We do not heat water or use the electric geyser and we wash the dishes in cold water.	0	1	1
We do not heat water or use the electric geyser, we leave water outside in the sun and we use a solar geyser.	0	1	1
We do not heat water or use the electric geyser and we use less firewood.	0	1	1

We do not heat water or use the electric geyser, we use more kerosene and firewood and we only heat the water slightly.	0	1	1
We do not heat water or use the electric geyser; we use less kerosene and heat water outside in the sun.	0	1	1
We wash and do not bath, and we heat the water outside in the sun.	1	0	1
We only heat the water slightly and we heat the water outside in the sun.	1	0	1
We only heat the water slightly.	1	0	1
We use more firewood for water heating and heat the water outside in the sun.	1	0	1
We use more firewood for water heating.	1	2	3
We use more gas and firewood for water heating.	1	0	1
We do not use the electric geyser, we use more kerosene and we heat the water only slightly.	1	0	1
We do not heat water and we only heat the water slightly.	2	0	2
We do not heat water; we use less gas and only heat the water slightly.	2	0	2
We do not heat water; we use less kerosene, heat the water slightly and heat water outside in the sun.	1	0	1
We do not heat water; we use less kerosene and coal, heat the water only slightly and heat the water outside in the sun.	1	0	1
We do not heat water and we do not use the electric geyser.	2	0	2
We do not heat water; we use more firewood and only heat the water slightly.	1	1	2
We do not heat water or use the electric geyser; we use more gas, heat the water only slightly and heat water in the sun.	2	0	2
We do not heat water or use the electric geyser and we heat water outside in the sun.	1	0	1
We do not heat water or use the electric geyser and we use more firewood for water heating.	3	0	3
We do not heat water or use the electric geyser and we use more gas for water heating.	1	0	1
We do not heat water or use the electric geyser; we heat the water only slightly, wash and do not bath and heat water outside in the sun.	1	0	1
We do not heat water or use the electric geyser; we use less kerosene and heat water outside in the sun.	2	0	2
We do not heat water or use the electric geyser and only heat the water slightly.	1	1	2
We do not heat water, do not use the electric geyser and use more kerosene.	2	0	2
Total	29	28	57

Table 17: Besides cooking appliances, what other electronic appliances/devices do you use?			
	E	FBE	Total
Fridge, television, DVD player, mobile phone charger, iron and a radio player.	0	1	1
Deep freezer, television, laptop or computer, mobile phone charger and iron.	0	1	1
Deep freezer, television, DVD player, mobile phone charger and iron.	0	1	1
Deep freezer, television, DVD player, laptop or computer, mobile phone charger and iron.	0	1	1
Fridge, television, DSTV decoder, laptop or computer, mobile phone charger and iron.	0	1	1
Fridge, television, DVD player, mobile phone charger, Hi Fi and iron	0	1	1
Fridge, television, DVD player, mobile phone charger, iron, and other.	0	2	2
Fridge, television, DVD player, DStv decoder, laptop or computer, mobile phone charger, Hi Fi, and iron.	0	1	1
Fridge, television, DVD player, mobile phone charger, table lamp, and iron.	0	1	1
Fridge, deep freezer, mobile phone charger, and iron.	0	1	1
Fridge, television, mobile phone charger, table lamp, and iron.	1	10	11
Fridge, television, DStv decoder, and mobile phone charger.	1	2	3
Fridge, television, mobile phone charger, and iron.	3	0	3
Fridge, television, mobile phone charger, iron, and vacuum cleaner.	2	0	2
Fridge, television, laptop or computer, mobile phone charger, and iron.	1	0	1
Fridge, television, mobile phone charger, and iron.	2	0	2
Fridge, television, DStv decoder, mobile phone charger, and iron.	1	1	2
Fridge, television, mobile phone charger, Hi Fi, and iron.	1	0	1
Fridge, television, mobile phone charger, and iron.	2	0	2
Fridge, television, DVD player, mobile phone charger, and iron.	1	1	2
Fridge, television, DVD player, laptop or computer, mobile phone charger, table lamp, Hi Fi, and iron.	1	0	1
Fridge, television, DVD player, laptop or computer, mobile phone charger, Hi Fi, and iron.	1	0	1
Fridge, television, DVD player, DStv decoder, mobile phone charger, and iron.	3	0	3
Fridge, television, DVD player, DStv decoder, mobile phone charger, table lamp, iron, and vacuum cleaner.	1	0	1
Fridge, television, DVD player, DStv decoder, mobile phone charger, and iron.	1	3	4
Fridge, television, DVD player, DStv decoder, mobile phone charger, Hi Fi, and iron.	2	0	2
Fridge, deep freezer, television, mobile phone charger, and iron.	1	0	1
Fridge, deep freezer, television, DStv decoder, mobile phone charger, and iron.	3	0	3

Fridge, deep freezer, television, DVD player, DStv decoder, mobile phone charger, iron, and table lamp.	1	0	1
Fridge, deep freezer, television, DVD player, DStv decoder, mobile phone charger, and iron.	1	2	3
Total	30	30	60

Table 18: How has access to electricity benefitted your household?

	E	FBE	Total
We use less dirty fuels, can use a fridge, charge our phones, watch television, use the internet and it has improved our access to information.	0	2	2
We have more money because we spend less on fuels and it has improved our access to information.	0	1	1
We can use a fridge, charge or mobile phones, watch television and use the internet.	0	1	1
We can use a fridge and charge our mobile phones.	0	1	1
It has improved our access to information.	2	2	4
We can use a fridge and watch television.	1	0	1
We can use a fridge.	1	0	1
We can use a fridge, charge our phones and have improved access to information.	1	0	1
We can use a fridge, charge our phones and watch television.	5	4	9
We can use a fridge, charge our phones, watch television, use the internet and it has improved our access to information.	4	3	7
We can use a fridge, charge our mobile phones, watch television and have improved access to information.	5	2	7
We can use a fridge, charge our mobile phones, watch television, have more money because we save on using less fuels and have improved access to information.	1	0	1
We use less dirty fuels, can charge our mobile phones and watch television.	1	0	1
We use less dirty fuels, can use a fridge, charge our mobile phones and watch television.	6	11	17
We use less dirty fuels, can use a fridge, charge our phones, watch television and it has improved our access to information.	3	3	6
Total	30	30	60

Table 19: Which appliances do you find you can use more with the assistance of the FBE?

	FBE
We can use the radio more often.	1
We can use the DStv decoder and iron more often.	1

We can use the iron more often.	1
We can use the mobile phone charger more often.	1
We can use the deep freezer, television, DVD player, laptop/computer, mobile phone charger, table lamp and iron more often.	1
We can use the deep freezer, television, mobile phone charger and iron more often.	1
We can use the deep freezer, television and iron more often.	1
We can use the television, DVD player, mobile phone charger, table lamp and iron more often.	1
We can use the fridge more often.	2
We can use the fridge and iron more often.	1
We can use the fridge, television and iron more often.	1
We can use the fridge and television more often.	1
We can use the fridge, television and radio player more often.	1
We can use the fridge, television, DStv decoder, mobile phone charger and iron more often.	1
We can use the fridge, television, mobile phone charger and iron more often.	5
We can use the fridge, television and mobile phone charger more often.	4
We can use the fridge, television, DStv decoder and mobile phone charger more often.	1
We can use the fridge, television, DVD player and mobile phone charger more often.	1
We can use the fridge, television, DVD player, DStv decoder, laptop/ computer, mobile phone charger and iron more often.	1
We can us the fridge, television, DVD player, DStv decoder, mobile phone charger and iron more often.	1
We can use the fridge and deep freezer more often.	1
Total	29

Table 20: What strategy/strategies do you make use of to save energy on using appliances?

	E	FBE	Total
We watch less television and sometimes use a non-electric iron.	0	1	1
We only iron once a week.	0	1	1
We watch less television and we switch the fridge off when we run short of money or low on electricity.	0	1	1
We do not switch the fridge on during the day, we watch less television and we try to use appliances a little as possible in winter.	0	1	1
We only use the fridge in the summer and watch less television.	0	1	1
We only use the fridge in the summer during the day.	0	1	1
We only use the fridge in the summer during the day and we try to use appliances as little as possible in the winter.	0	1	1

We only use the fridge in the summer during the day and we watch less television.	0	1	1
We watch less television and we do not use the vacuum cleaner.	2	0	2
We switch the fridge off when we run short on money or low on electricity.	2	0	2
We iron only twice a week.	1	0	1
We watch less television and we iron only once a week.	0	1	1
We try to use appliances as little as possible in winter.	7	6	13
We watch less television.	3	5	8
We watch less television and we try to use appliances as little as possible in winter.	3	2	5
We buy food that does not need refrigeration and we watch less television.	1	0	1
We buy food that does not need refrigeration and we try to use appliances as little as possible in the winter.	4	1	5
We only use the fridge during the day and we watch less television.	0	1	1
We only use the fridge in the summer.	1	2	3
We only use the fridge in the summer and we buy food that does not need refrigeration.	1	0	1
We only use the fridge in the summer in the day or on very hot days and we buy food that does not need refrigeration.	1	0	1
Total	26	26	52

Table 21: How has access to the FBE benefitted your household?

	FBE
We can use a washing machine.	1
We have more money to spend on groceries, transport and education and we can use appliances that we could not use before.	1
We can use appliances that we could not use before and we can cook dishes that we could not cook before.	2
We can have the fridge on all the time, we use less dirty fuels, watch television for as long as we want to, use appliances that we could not use before and afford to cook dishes that we could not cook before.	1
We can have the fridge on all the time, watch television for as long as we want and use appliances that we could not use before.	1
We can have the fridge on all the time, watch television for as long as we want and afford to cook dishes that we could not cook before.	1
We can have the fridge on all the time and use less dirty fuels.	2
We can have the fridge on all the time and watch television for as long as we want.	5
We can have the fridge on all the time, we use less dirty fuels and we can use appliances that we could not use before.	1
We can have the fridge on all the time and use appliances that we could not use before.	1

We can have the fridge on all the time, have more money to spend on groceries and medical expenses, watch television for as long as we want and use appliances that we could not use before.	1
We can leave the lights on for longer, have more money to spend on groceries and watch television for as long as we want to.	1
We can leave the lights on for longer, watch television for as long as we want to and use appliances that we could not use before.	1
We can leave the lights on for longer.	1
We can leave the lights on for longer, have the fridge on all the time and we use less dirty fuels.	1
We can leave the lights on for longer, have the fridge on all the time, have more money to spend on groceries, transport, medical expenses and education.	1
We can leave the lights on for longer, we can have the fridge on all the time, we have more money for transport, use less dirty fuels, watch television for as long as we want to, use appliances that we could not use before and cook dishes that we could not cook before.	1
We can leave the lights on for longer, have the fridge on all the time, watch television for as long as we want to, use appliances that we could not use before and cook dishes that we could not afford to cook before.	1
We can leave the lights on for longer, have the fridge on all the time, use less dirty fuels and watch television for as long as we want to.	2
We can leave the lights on for longer, have the fridge on all the time, we have more money for groceries, education, we use less dirty fuels, watch television for as long as we want to, and use appliances that we could not afford to use before.	1
We can leave the lights on for longer, have the fridge on all the time, we have more money for transport, use less dirty fuels, watch television for has long as we want, use appliances that we could not afford to use before and cook dishes that we could not afford to cook before.	1
We can leave the lights on for longer, have the fridge on all the time and watch television for as long as we want.	2
Total	30

Table 22: The reason/s why we use electricity

	E	FBE	Total
We use electricity because it is convenient, available and its use enhances our status.	0	1	1
We use electricity because it a healthier energy to use and its use enhances our status.	0	1	1
We use electricity because it is convenient, food taste better when prepared with it and it is a healthier energy to use.	0	2	2

We use electricity because it is convenient, available and it is a healthier energy to use.	0	7	7
We use electricity because it is affordable, convenient, available and it is a healthier energy to use.	0	1	1
We use electricity because food taste better when prepared with it and it is a healthier energy to use.	1	0	1
We use electricity because food taste better when prepared with it, it is a healthier energy to use, and its use enhances our status.	1	0	1
We use electricity because it is a healthier energy to use.	3	1	4
We use electricity because it is convenient.	3	4	7
We use electricity because it is convenient and a healthier energy to use.	5	1	6
We use electricity because it is convenient, it is a healthier energy to use and its use enhances our status.	4	2	6
We use electricity because it is convenient, food taste better when prepared with it, it is a healthier energy to use and its use enhances our status.	6	4	10
We use electricity because it is available and a healthier energy to use.	1	0	1
We use electricity because it is convenient, available, food taste better when prepared with it, it is a healthier energy to use and its use enhances our status.	1	3	4
We use electricity because it is convenient, available, food taste better when prepared with it and it is a healthier energy to use.	2	1	3
We use electricity because it is affordable, convenient, available, food taste better when prepared with it, it is a healthier energy to use and its use enhances ours status.	0	1	1
We use electricity because it is affordable, convenient, available, food taste better when prepared with it and it is a healthier energy to use.	3	0	3
Total	30	29	59

Table 23: The reason/s why we use candles

	E	FBE	Total
We use candles because it is available.	0	3	3
We use candles because it is affordable and a healthier energy to use.	1	1	2
We use candles because it is affordable and available.	6	6	12
We use candles because it is affordable.	17	9	26
We use candles because it is affordable, convenient and available.	0	1	1
Total	24	20	44

Table 24: The reason/s why we use kerosene		
	E	FBE
We use kerosene because it is a healthier fuel to use.	0	1
We use kerosene because it is available.	6	1
We use kerosene because it is convenient and available.	2	1
We use kerosene because it is affordable and available.	3	7
We use kerosene because it is affordable.	4	9
We use kerosene because it is affordable and convenient.	1	0
We use kerosene because it is affordable, convenient and available.	3	1
Total	19	20

Table 25: The reason/s why we use firewood		
	E	FBE
We use firewood because food taste better when prepared with it.	0	1
We use firewood because it is convenient and available.	0	1
We use firewood because it is available.	0	1
We use firewood because it is affordable, convenient, available and food taste better when prepared with it.	0	2
We use firewood because it is convenient.	2	0
We use firewood because it affordable and available.	1	2
We use firewood because it is affordable and food taste better when prepared with it.	1	4
We use firewood because it is affordable, available and food taste better when prepared with it.	1	0
We use firewood because it is affordable.	3	5
We use firewood because it is affordable, convenient and available.	5	3
Total	13	19

Table 26: The reason/s why we use gas		
	E	FBE
We use gas because it is affordable, available and a healthier energy to use.	0	1
We use gas because it is available and food taste better when prepared with it.	1	0
We use gas because it is available.	1	1
We use gas because it is convenient and available.	2	1
We use gas because it is convenient.	3	0
We use gas because it is affordable.	1	0
Total	8	3

Table 27: How do you manage to afford the extra you spend on energy in the winter?

	E	FBE
We spend less money on groceries and transport.	6	2
We spend less money on groceries.	8	10
We spend less money on groceries and traveling, we buy more cooked meals and we buy more food that is canned and cereals.	1	0
We spend less money on groceries and buy more cooked meals.	1	1
We spend less money on transport.	4	3
We spend less on traveling, buy more cooked meals, cook food in bulk and heat it slightly before eating.	1	0
Family members sometimes help us by giving money.	1	0
We spend less money on groceries and use more gas.	2	0
We spend less money on groceries and use cheaper fuels.	1	1
We switch off all unused appliances.	0	1
We use appliances as little as possible.	0	1
We spend less money on groceries and use cheaper fuels for heating water.	0	1
We spend less on groceries, use cheaper fuels and we use appliances as little as possible.	0	2
We spend less money on groceries and I do extra jobs in winter.	0	1
We spend less money on groceries and we collect empties to make extra money.	0	1
We spend less money on groceries, by more cooked meals and I sell Avon to earn extra money.	0	1
We spend less money on groceries and we buy canned food a limit cooking.	1	0
We spend less money on groceries, we use cheaper fuels and we do not use the fridge.	2	0
Total	28	25

Table 28: How does the high cost of energy affect your household?

	E	FBE
It made my children's education unaffordable, I cannot buy enough food or nutritious food for my family, I spend a lot of time shopping looking for cheaper food, using dirty fuels is affecting the health of all of us, I do not have enough money for transport, I spend a lot of time gathering/buying energy, I cannot afford to pay medical bills or customary social events such as wedding etc. and it is making me feel depressed, low, hopeless and desperate	1	0
It made my children's education unaffordable, I cannot afford to buy enough food or nutritious food for my family, I spend a lot of time shopping looking for cheaper food, using dirty fuels is affecting the health of all of us, my relationship with family members is suffering because of energy poverty, I do not' have enough money for transport, I spend a lot of time gathering/buying energy, I cannot afford to pay medical bills or afford customary social events such as weddings and it is making me feel depressed, low, hopeless and desperate	1	0
It made my children's education unaffordable, I cannot afford to buy enough food or nutritious food for my family, I spend a lot of time shopping looking for cheaper food, using dirty fuels is affecting the health of all of us, I spend a lot of time gathering/buying energy, I cannot afford to pay medical bills or afford customary social events such as weddings etc., it is affecting my standing in the community and it is making me feel depressed, low, hopeless and desperate.	1	0
It made my children's education unaffordable, I cannot afford to buy enough food or nutritious food for my family and I spend a lot of time shopping looking for cheaper food.	1	0
It made my children's education unaffordable, I cannot afford to buy enough food or enough nutritious food for my family, I spend a lot of time shopping looking for cheaper food, I do not have enough money for transport, I cannot afford to pay medical bills or afford customary social events such as wedding etc.	1	0
It made my children's education unaffordable, I cannot afford to buy enough food and enough nutritious food for my family and I spend a lot of time shopping looking for cheaper food.	1	1
If made my children's education unaffordable, I cannot afford to buy enough food and enough nutritious food for my family, I spend a lot of time shopping looking for cheaper food, my relationship with family members is suffering because of energy poverty and I cannot afford to pay medical bills	2	0
It made my children's education unaffordable and I cannot afford to buy enough food and enough nutritious food for my family	1	0
It made my children's education unaffordable and I cannot afford to buy enough food for my family	1	0

It made my children's education unaffordable, I cannot afford to buy enough food for my family, I spend a lot of time shopping looking for cheaper food, using dirty fuels is affecting the health of all of us, my relationship with family members is suffering because of energy poverty, I spend a lot of time gathering/buying energy, I do not have money to spend on customary social events such as weddings etc. and it is making me feel depressed, low, hopeless and desperate,	1	0
I spend a lot of time shopping looking for cheaper food and it is making me feel depressed, low, hopeless and desperate	1	0
I cannot afford to buy enough food for my family and the use of dirty fuels is affecting the health of all of us	1	0
I cannot buy essential things for a decent living like a car, a satellite dish or throw a decent birthday party for my children	1	0
I cannot afford to buy enough food for my family, I do not have enough money for transport, I cannot afford to pay medical bills or have money for social events such as weddings etc.	1	0
I cannot afford to buy enough food or nutritious food for my family and I spend a lot of time shopping looking for cheaper food.	1	0
I cannot afford to buy enough food and nutritious food for my family, I spend a lot of time shopping looking for cheaper food, I cannot buy essential things for a decent living, I spend a lot of time gathering/buying energy, I cannot afford to pay medical bills or have money for customary social events such as weddings etc. and it is making me feel depressed, low, hopeless and desperate.	1	0
I cannot buy enough food and enough nutritious food, I spend a lot of time shopping looking for cheaper food, using dirty fuels is affecting the health of all of us and it is making me feel depressed, low hopeless and desperate	1	0
I cannot buy enough food and enough nutritious food for my family, I spend a lot of time gathering/buying energy and I do not have money for customary social events such as weddings etc.	1	0
I cannot afford to buy enough food and nutritious food for my family, I do not have enough money for transport and I cannot afford to pay medical bills	1	0
I cannot afford to buy enough food for my family and I spend a lot of time shopping looking for cheaper food.	1	0
I cannot afford to buy enough food for my family	1	1
I cannot afford to buy enough food for my family, I spend a lot of time shopping looking for cheaper food, using dirty fuels is affecting the health of the cook, I do not have enough money for transport and energy poverty is making me feel depressed, low, hopeless and desperate.	1	0
I cannot afford to buy enough food for my family, I spend a lot of time shopping looking for cheaper food, I do not have enough money for transport, I spend a lot of time gathering/buying energy and it is making me feel depressed, low, hopeless and desperate.	1	0

I cannot afford to buy enough food for my family, I cannot buy essential things for a decent living and it is making me feel depressed, low, hopeless and desperate	1	0
I cannot afford to buy nutritious food for my family, I spend a lot of time shopping looking for cheaper food and I do not have enough money for transport	1	0
I spend a lot of time shopping looking for cheaper food	1	0
I cannot afford to buy nutritious food for my family, I do not have enough money for transport, I cannot afford to pay medical bills and it is affecting my standing in the community	1	0
Using dirty fuels is affecting the health of the children, I spend a lot of time gathering/buying energy, I cannot afford to pay medical bills and it is making me feel depressed, low, hopeless and desperate	1	0
It is making me feel depressed, low, hopeless and desperate	1	0
It has made my own education and my children's education unaffordable, I cannot afford to buy enough food and enough nutritious food for my family and I spend a lot of time shopping looking for cheaper food	0	1
It has made my own education and my children’s education unaffordable, using dirty fuels is affecting the health of all of us, my relationship with family members is suffering because of energy poverty, I spend a lot of time gathering/buying energy and I cannot afford to pay medical bills	0	1
It has made my own education unaffordable, I cannot afford to buy enough food and nutritious food for my family, I spend a lot of time shopping looking for cheaper food, I cannot afford customary social events such as weddings etc. and it is making me feel depressed, low, hopeless and desperate.	0	1
It has made my own education unaffordable, I cannot afford to buy enough food and nutritious food for my family, I cannot afford to pay medical bills and it is making me feel depressed, low, hopeless and desperate.	0	1
I cannot afford to buy enough food and nutritious food for my family	0	1
It has made my children’s education unaffordable, I cannot afford to buy enough food and enough nutritious food for my family, I spend a lot of time shopping looking for cheaper food, using dirty fuels is affecting the health of all of us, I cannot buy essential things for a decent living, I spend a lot of time gathering/buying energy, I cannot afford customary social events such as weddings etc. and it is affecting my standing in the community	0	1
It has made my children's education unaffordable, I cannot afford to buy enough food and enough nutritious food for my family, I spend a lot of time shopping looking for cheaper food, using dirty fuels is affecting the health of all of us, I do not have enough money for transport, I spend a lot of time gathering/buying energy, I cannot afford to pay medical bills or have money for customary social events such as weddings etc.	0	1

It made my children's education unaffordable, I cannot afford to buy enough food and enough nutritious food for my family, I spend a lot of time shopping looking for cheaper food, using dirty fuels is affecting the health of all of us, my relationship with family members is suffering because of energy poverty, I cannot buy essential things for a decent living, I do not have enough money for transport and it is making me feel depressed, low, hopeless and desperate	0	1
It made my children's education unaffordable	0	1
It made my children's education unaffordable, I cannot afford to buy enough food and enough nutritious food for my family, I spend a lot of time shopping looking for cheaper food, I spend a lot of time gathering/buying energy, I cannot afford to pay medical bills or afford customary social events such as weddings etc. and it is making me feel depressed, low, hopeless and desperate	0	1
It has made my children's education unaffordable, I cannot afford to buy enough food and nutritious food for my family, using dirty fuels is affecting the health of all of us and I do not have enough money for transport.	0	1
It has made my children's education unaffordable, I cannot afford to buy enough food for my family, using dirty fuels is affecting the health of all of us, I cannot buy essential things for a decent living and it has made my family more vulnerable to crime.	0	1
It has made my children's education unaffordable, I cannot afford to buy enough nutritious food for my family, I spend a lot of time shopping looking for cheaper food, using dirty fuels is affecting the health of all of us, I spend a lot of time gathering/buying energy, I cannot afford to pay medical bills and it is making me feel depressed, low, hopeless and desperate	0	1
I spend a lot of time gathering/buying energy, I cannot afford to pay medical bills or afford customary social events such as weddings etc. and it is making me feel depressed, low, hopeless and desperate	0	2
I cannot afford to buy enough and/or nutritious food, I spend a lot of time shopping looking for cheaper food, using dirty fuels is affecting the health of all of us, I spend a lot of time gathering/buying energy, I cannot afford customary social events such as wedding etc., and it is making me feel depressed, low, hopeless and desperate	0	1
I cannot afford to buy enough food and nutritious food for my family, I spend a lot of time shopping looking for cheaper food, using dirty fuels is affecting the health of all of us, I spend a lot of time gathering/buying energy, I cannot afford to pay medical bills or pay for customary social events such as weddings etc. and it is affecting my standing in the community.	0	1
I cannot afford to buy enough food and nutritious food for my family, I spend a lot of time shopping looking for cheaper food, using dirty fuels is affecting the health of all of us and I cannot afford to pay medical bills	0	1
I cannot afford to buy enough food and nutritious food, I spend a lot of time shopping looking for cheaper food, using dirty fuels is affecting the health of all of us, my relationship with family members is suffering because of energy poverty, I cannot buy essential things for a decent living and I spend a lot of time gathering/buying energy	0	1

I cannot afford to buy enough food and nutritious food, I spend a lot of time shopping looking for cheaper food, using dirty fuels is affecting the health of all of us and I cannot buy essential things for a decent living	0	1
I cannot afford to buy enough food for my family, I spend a lot of time shopping looking for cheaper food and it is affecting my standing in the community	0	1
I cannot afford to buy enough food for my family, using dirty fuels is affecting the health of all of us, I cannot afford to pay medical bills and I feel depressed, low, hopeless and desperate.	0	1
I cannot afford to buy enough food for my family, using dirty fuels is affecting the health of all of us, I spend a lot of time gathering/buying energy, I cannot pay medical bills and it is making me feel depressed, low, hopeless and desperate.	0	1
I spend a lot of time shopping looking for cheaper food and using dirty fuels is affecting the health of the children	0	1
I cannot afford to pay for customary social events such as weddings etc.	0	1
I spend a lot of time shopping looking for cheaper food, I do not have money for transport, I spend a lot of time gathering/buying energy and I cannot afford to pay medical bills.	0	1
Using dirty fuels is affecting the health of all of us, I do not have money for transport, I cannot pay medical bills or afford customary social events such as wedding etc.	0	1
Using dirty fuels is affecting the health of all of us, I do not have money for transport, I can't pay medical bills or afford customary social events such as weddings etc.	0	1
Total	30	30

Table 29: What do you think government should do to help people meet their energy needs?

	E	FBE
Provide all households with a subsidy to purchase solar cookers.	0	1
Provide a subsidy to purchase gas and kerosene.	1	0
Provide all households with a subsidy to purchase solar geysers.	2	1
Provide all households with a subsidy to purchase solar geysers and gas.	7	1
Provide all RDP houses with solar geysers and a subsidy to purchase a generator.	1	1
Provide al RDP houses with solar geysers.	3	3
Provide all RDP houses with solar geysers and a subsidy to purchase gas.	1	2
Provide all households with a subsidy to purchase solar geysers and solar cookers.	6	5
Provide al RDP houses with solar geysers and provide a subsidy to purchase solar cookers.	5	13
Provide all RDP houses with solar geysers and all households with a subsidy to purchase solar geysers.	3	1
Provide all RDP houses with solar geysers and all households with a subsidy to purchase solar geysers and kerosene.	1	0
Total	30	28